Georgia Department of Transportation

TRAFFIC SIGNAL DESIGN GUIDELINES

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GEORGIA DEPARTMENT OF TRANSPORTATION
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Section 1
INTRODUCTION

The purpose of these design guidelines is to document standards, procedures and specifications that shall be used for the design of traffic signal installations and signal system communications for the Georgia Department of Transportation (GDOT). These design guidelines include a compilation of specific drafting and intersection design standards, plan and specification presentations, and review procedures to ensure that construction documents properly convey the extent and character of the work to be performed. Sound traffic engineering judgement should be exercised in applying these guidelines. Along with the companion document on Signing and Marking design, these documents contain comprehensive guidelines intended to provide for consistency in plans for traffic control devices.

1.1 Applicable Standards and Specifications

The specific documents that will govern all work efforts are the following:

- *GDOT Standard Specifications - Construction of Transportation Systems*, latest edition and supplements thereto. Documents listed below give more detail concerning specific traffic engineering design elements, but all work must be in accordance with the GDOT Standard Specifications - Construction of Transportation Systems. Special attention should be paid to the following sections:

  636 – Signs
  639 – Poles & Span Wire
  647 – Traffic Signal Installation
  682 – Electrical Wire, Cable & Conduit
  687 – Traffic Signal Timing
  925 – Traffic Signal Equipment
  935 – Fiber Optic Cable
  938 –Detection
  939 – Communication and Electronic Equipment

- *GDOT Traffic Signal Detail Sheets*
- *GDOT Standard Detail Sheets*
- *GDOT Construction Details*
- *GDOT Plans Presentation Guide*
- *GDOT Electronic Data Guidelines (EDG)*
- *GDOT NaviGAtor ATMS Design Manual*
- *Manual on Uniform Traffic Control Devices*, Latest Edition adopted by GDOT. This document shall govern those aspects of the application of all signs, signals and pavement markings not specifically covered by the above materials.
- *A Policy on Geometric Design of Highways and Streets*, Latest Edition adopted by GDOT. Design standards outlined in this publication shall govern most geometric considerations. Metric units are used in this edition and a "soft" conversion should be used for projects designed in Imperial (English) units.
- *Americans with Disabilities Act (ADA)*
- *National Electrical Code*, Latest Edition. This document shall govern the electrical aspects of all signal installations.
- *Locating Detectors for Advanced Traffic Control Strategies*, (Report No. FHWA-RD-75-91), 1975.
- *Federal Highway Administration (FHWA) Guidelines for System Sensor Placement.*

- *American Association of State Highway Transportation Officials (AASHTO) Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals*. This document will provide criteria for structural design.

- *FHWA Work Zone Traffic Control Practices Manual.*

- *Standard Highway Signs (FHWA).* Wherever possible, designated traffic signs shall be as specified in this document.

- *Institute of Transportation Engineers (ITE) Manual of Traffic Signal Design*

- *Transportation Electrical Equipment Specifications*, current edition and current addenda. These specifications are referenced by GDOT's Traffic Signal Equipment specifications.

Section 2
GENERAL INFORMATION

The following standards apply to the preparation and presentation of signalization plans.

2.1 Drafting Standards

All plans submitted shall be on full-size sheets, 36 inches by 24 inches. Drafting of the plans packages will be done using a version of MicroStation Computer Aided Drafting and Design (CADD) approved by GDOT. Drafting standards shall meet all guidelines established in the *GDOT Plans Presentation Guide* and the *GDOT Electronic Data Guidelines (EDG)*. A CD-ROM computer disc containing the CADD files (in MicroStation 2-D CADD format) used by the project (to include the final plan sheets and all displayed reference files) shall be submitted with the plotted final plans. The submittal of final plotted plans shall include one full-size set (36 inches x 24 inches) and one half-size set (18 inches x 12 inches).

Note: The GDOT Automated Data/Design Standards Committee (ADDS) has developed a variety of GDOT approved CADD standards and set-up files. These files may be available on the GDOT web page. (The current URL for this GDOT ADDS information is http://tomcat2.dot.gaus/stds_dtis/index.jsp, but this address is subject to change.)

2.1.1 Electronic File Structure

The EDG establishes a file structure for MicroStation files used by GDOT for roadway design projects. Table 2-1 summarizes the file structure to be used for organizing the design work for signal and communication plans. All file names must use the PI number as part of the file name, per the EDG. An example PI number (123456) is used below. (Note: All MicroStation files developed for GDOT should be derived from the GDOT 2-D MicroStation seed file.)

Table 2-1 MicroStation File Structure for Signal Plans

FILE NAME	DESCRIPTION
123456SIG.dgn	One file that contains all line work for signal and communication system improvements in a project.
123456SIG##.dgn	A separate file will be made for each intersection at which signal improvement work will occur. This file contains all call-outs, tables, notes, etc.
123456COMM##.dgn	A separate file that contains all call-outs, tables, notes, etc, required for the communication system improvements.

2.1.1.1 Reference Files

Each of the files explained above must have reference files attached in order to do the design and create plan sheets. These include, but are not limited to, the following files:

- Base Files – These will be either mapping files or roadway design files, depending on if the signal improvements are a stand alone project or a part of a roadway improvement project.
- Property File – This file has the existing right of way and property lines.
- Signing & Marking and Utility Files – These files will be needed only when signals are a part of a roadway improvement project.

Level schedule and file naming information can be found in the EDG.

2.1.1.2 Signal Design File (SIG.dgn) Level Structure

The signal design file shall contain the overall signal design for all intersections and the communication system design. This file is a reference file for both signal plans and communication plans and is not actually a part of the plan set without modification. This allows for the controller cabinet, poles, etc. from the intersection design to also appear in the communication design. The level structure for proposed signal improvement items shall be as shown in Table 2-2.

Table 2-2 Level Structures

LEVEL	DATA ELEMENTS
52	Utility Information (if not provided in a reference file)
53	Notes
54	Signal Poles
55	Controller Cabinet and Communication System Equipment
56	Span Wire, Mast Arms, Street Lights
56	Vehicular and Pedestrian Signal Heads
56	Loops and Lead-ins
56	Signal Conduit and Pull Boxes

2.1.1.3 Signal Plan File (SIG##.dgn) Structure

A file shall be created for each intersection with the intersection number replacing the number symbols in the file designation. Two (or three) views should be created in each file. For signal designs and/or system upgrades only, View 1 should be for the existing conditions sheet. View 2 should be for the Construction/Installation Sheet and View 3, if needed, should be for a second Construction/Installation Sheet to show signal operations details. If the signal is part of a roadway improvement project, then only View 2 (and View 3, if needed) is required.

The call-outs, tables, and notes that are needed for the signal construction shall be a part of these plan sheet files and should appear on levels 56, 57 and 58 of this file. Level 56 of the SIG##.dgn should contain the installation notes and callouts which pertain to construction/installation issues. Level 58 should contain the tables and notes pertaining to signal operations (e.g., cabinet input file assignment) and Level 57 should contain items common to both (e.g. signal head and detector numbering). If all required information can fit onto one Construction/Installation Sheet, then View 2 should display all three levels (i.e. levels 56-58). When an additional view is needed, View 2 (Construction/Installation) should display Levels 56 and 57, and View 3 (Signal Operations) should display levels 57 and 58.

Table 2-3 define the contents and levels that should be active from the SIG.dgn file in each view. To determine the levels that should be active from other reference files, consult the EDG. All reference files that are attached to the Signal Plan file shall be clipped to fit a title and border like the example plans in Appendix A.

Table 2-3 Levels to Have Active from the SIG.dgn Reference File

VIEW 1: EXISTING CONDITIONS	
LEVEL	CONTENTS
None	

VIEW 2 and 3: CONSTRUCTION/INSTALLATION	
LEVEL	CONTENTS
52-56	See Section 2.1.1.2

In order for the design elements to be easily understood, items in the reference files may be shown in gray scale as necessary. For instance, when a signal plan is part of a roadway improvement plan set, the proposed drainage structures, utilities and striping may be shown in gray scale in order for the signal design elements to stand out.

2.1.1.4 Fonts

Text in the SIG##.dgn files should be "Engineering" Font in the GDOT font.rsc file. The font.rsc file is a MicroStation resource file and is available from the Office of Traffic Safety and Design. A text height and width of 4 can be used for both 1"=30' and 1"=20' scale plan sheets.

2.1.1.5 Signal Design Cell File

A signal design cell file contains standard cells for items such as signal heads, phasing diagrams and lists of materials. The signal design cell file may be available from GDOT's Office of Traffic Safety & Design. The signal design cell file (as well as other GDOT design cell files) may also be available from the GDOT website.

2.2 Signal Plan Presentations

Varying degrees of information shall be presented for each intersection and "design clutter" should be avoided. Reference file data that does not pertain to the signal design should be suppressed and data of secondary importance should be screened back. The primary determinant in this respect shall be the amount of work to be done (for example,

is the intersection to be completely rebuilt or will the controller simply be replaced). The following is a description of the methods for presenting this information.

2.2.1 Existing Condition Sheets

Existing Condition Sheets shall be prepared for all intersections, using a scale of 1"=30' or larger. The main street shall be oriented horizontally across the sheet. Existing Condition Sheets should show features pertinent to the work to be done and shall include the following items:

- North arrow (up or pointing to the right)
- Scale, shown with a horizontal bar scale
- Street names and State Highway designations
- Right-of-way and limited access
- Known underground utilities which fall within the right of way or within 10 feet of underground construction
- Curb ramps
- Sidewalks
- Curb or edge of pavement lines
- Median nose locations
- Driveways
- Existing drainage structures
- Pavement markings
- Vehicular and pedestrian signal heads
- Signal interconnect and related hardware
- Signal and utility poles
- Span wire
- Controller and cabinet
- Pull boxes and conduit
- Loops
- Surface evident utility features
- Overhead utility lines
- Structures

2.2.2 Construction/Installation and Signal Operations Sheets

Intersections shall be shown, one intersection per sheet, at a scale of 1" = 30' or larger. The construction sheets should show (or reference) all information and details necessary for the contractor to complete the work. The following general items shall be displayed:

- North arrow and scale
- Final right-of-way (i.e., do not show existing R-O-W lines which fall within the proposed R-O-W)
- Vehicular and pedestrian signal head diagram
- Signal phasing diagram (or phasing flow chart)
- Cabinet input file assignment chart
- List of materials
- Notes (applicable to this intersection)
- All installation measures required
- Pavement markings

The Construction/Installation Sheets shall also indicate all installation and construction measures required by the contractor. Plan sheets shall use symbols, call-outs, and notes as required to clearly describe all work to be performed by the contractor. The installation measures shall consist of the following items:

- New controller and/or cabinet
- Miscellaneous conduit and pull boxes
- Vehicle detector loops, where needed
- System sensors, where applicable
- Electrical service point
- Signal head details for proposed heads (including pedestrian heads)
- Surrounding surface materials to be replaced (grass, asphalt, concrete, etc)
- Signal poles
- Span or mast arm layout as applicable
- Proposed pavement markings
- Proposed signal related signs

- Proposed curb and gutter
- Proposed curb ramps
- Proposed sidewalks and landings
- Proposed islands

In most cases, a traffic signal design will require only one Construction/Installation sheet. However, there will be some cases where a traffic signal design will require the use of more installation notes or other required documentation than can be practically displayed on a single plan sheet. When a two-sheet format is needed, the sheets should be arranged so that the list of materials, the phasing diagram and the input file are shown on the second Construction/Installation Sheet.

2.2.3 List of Materials/Pay Items

Section 647 of the *GDOT Standard Specifications - Construction of Transportation Systems* defines the requirements for the work consisting " . . . of furnishing materials and erecting a traffic signal installation . . ." Payment for this work as defined in Section 647.5, calls for a lump price bid covering all items of work unless pay items are included in the plans for specific, individual items.

A list of materials shall be included in the plans on the Construction/Installation sheet to show the items and quantities to be installed and paid for under the lump sum pay item (647-1000 Traffic Signal Installation). The list of materials shown in Table 2-4 contains examples of items, which might be included in a typical design. The table is a guide, **not** an all-inclusive list.

Table 2-5 is a sample list of pay items that are typically used for traffic signal and communication system installations. Please note that this list is **not** all-inclusive. A pay item summary shall be included in the Summary of Quantities and not on the Construction/Installation sheet.

Table 2-4 List of Materials Paid for as Part of 647-1000 Lump Sum Pay Item

ITEM	UNIT	QUAN
CONTROL CABINET ASSEMBLIES		
A. CONTROLLER UNIT, MODEL 2070L	EA	
B. CABINET ASSEMBLY, MODEL 337 (FOUR PHASE) ATLANTA ONLY	EA	
C. CABINET ASSEMBLY, MODEL 336S (EIGHT PHASE)	EA	
D. CABINET ASSEMBLY, MODEL 332	EA	
E. SWITCH PACK	EA	
F. DC ISOLATOR	EA	
G. LOOP DETECTOR, 2 CHANNEL	EA	
H. LOOP DETECTOR, 4 CHANNEL	EA	
I. AC ISOLATOR	EA	
J. CONFLICT MONITOR W/ EXTENDED FEATURES	EA	
HAYES SMARTMODEM (OR EQUIVALENT), 33.6 KB/S	EA	
TELEPHONE LINE DEDICATION AND MODEM HOOK-UP	EA	
PC 642-200 (OR EQUIVALENT), SURGE PROTECTOR	EA	
LOOP/PED LEAD-IN WIRE (SHIELDED, TWISTED(1000 FT) A. 3 PAIR, 18AWG	REEL	
SIGNAL CABLE (14 AWG) B. 7 CONDUCTOR PER 1000 FT.	REEL	
LOOP DETECTION WIRE (14 AWG, STRANDED/1000FT)	REEL	
ONE WAY, 3 SECTION, 12" LED SIGNAL HEAD, PLASTIC	EA	
ONE WAY, 4 SECTION, 12" LED SIGNAL HEAD, PLASTIC	EA	
ONE WAY, 5 SECTION, 12" LED SIGNAL HEAD, (CLUSTER) PLASTIC	EA	
BLANK OUT SIGN, FIBER OPTIC, 30" X 36" 1.C ONE FACE ONE MESSAGE 2.C TWO FACE TWO MESSAGE	 EA EA	
18" PEDESTRIAN LED SIGNAL HEAD, SIDE BY SIDE	EA	
PEDESTRIAN PUSH BUTTON AND SIGN	EA	
BACK PLATE FOR ONE-WAY, 3-SECTION, 12" SIGNAL HEAD	EA	
BACK PLATE FOR ONE-WAY, 4-SECTION, 12" SIGNAL HEAD	EA	
BACK PLATE FOR ONE-WAY 5-SECTION, CLUSTERED 12" SIGNAL HEAD	EA	
HARDWARE FOR SPANWIRE ERECTION	EA	
HARDWARE FOR MAST ARM ERECTION	EA	
HARDWARE FOR PEDESTAL ERECTION FOR 18" PEDESTRIAN SIGNAL HEADS, ONE-WAY MOUNTING	EA	
HARDWARE FOR PEDESTAL ERECTION FOR 18" PEDESTRIAN SIGNAL HEADS, TWO-WAY MOUNTING	EA	
HARDWARE FOR BRACKET ERECTION ON STEEL, CONCRETE OR WOOD POLES FOR 18" PEDESTRIAN SIGNAL HEADS, ONE-WAY MOUNTING	EA	
PULL BOX, TP 1	EA	
PULL BOX, TP 2	EA	
PULL BOX, TP 3	EA	

PEDESTAL POLE 10'	EA	
LOOP SAW CUT	LF	
CONDUIT, 1", RIGID	LF	
CONDUIT, 2", RIGID	LF	
CONDUIT, 2", TYPE 2 (PVC)	LF	
LEFT TURN YIELD ON GREEN SIGN	EA	
LEFT ON GREEN ARROW ONLY SIGN	EA	
R560-5, STATE LAW – STOP FOR PEDESTRIANS IN CROSSWALK SIGN	EA	
CLASS II TIMBER POLE W/GUYS (45')	EA	
PED PUSH BUTTON POST/PEDESTAL INCL FOOTING	EA	
MISC MATL TO COMPLETE INSTALLATION	LUMP	

Table 2-5 Pay Items for Traffic Signal and Communication System Installations

PAY ITEM	DESCRIPTION	UNIT	QUANTITY
647-1000	TRAFFIC SIGNAL INSTALLATION NO. _	LUMP	
639-2001	STEEL WIRE STRAND CABLE, ¼ IN	LF	
639-4004	STRAIN POLE, TP IV	EA	
647-2140	PULL BOX, PB-4	EA	
647-2150	PULL BOX, PB-5	EA	
682-6120	CONDUIT, RIGID, 2 IN	LF	
682-6233	CONDUIT, NONMETAL, TP3, 2 IN	LF	
935-1113	OUTSIDE PLANT FIBER CABLE, LOOSE TUBE, SINGLE MODE, 24 FIBER	LF	
935-1511	OUTSIDE PLANT FIBER OPTIC CABLE, DROP, SINGLE MODE, 6 FIBER	LF	
935-3103	FIBER OPTIC CLOSURE, UNDERGROUND, 24 FIBER	EA	
935-3203	FIBER OPTIC CLOSURE, AERIAL (SEALED), 24 FIBER	EA	
935-4010	FIBER OPTIC SPLICE, FUSION	EA	
935-5050	FIBER OPTIC PATCH CORD, SM	EA	
935-5060	FIBER OPTIC SNOWSHOE	EA	
935-6562	EXTERNAL TRANSCEIVER, DROP AND REPEAT, 1310 SINGLE MODE, (SIGNAL JOBS)	EA	
935-6572	EXTERNAL STAR TRANSCEIVER, 1310 SINGLE MODE, (SIGNAL JOBS)	EA	
935-8000	TESTING	LS	

2.3 Communications Plans

Communications plans shall consist of a Communication Routing Sheet and the Communication Plan Sheets. The Communication Routing Sheet is intended to illustrate the overall layout of the system and shall be drawn at an appropriate scale to show the entire communication network. Items to be shown shall include the following:

- North arrow and scale
- Street names and State Route designations

- Communications legend
- Cable routings
- Cable size
- Underground or aerial cable use
- Location of pull boxes
- Master controller location
- Local controller locations
- Pole, lines

Communication plan sheets shall use CADD-based roadway maps or aerials at a scale of 1" = 50'. The plans shall indicate all installation and construction measures required by the contractor. Text for notes shall be "Engineering" font with a text height and width of 6. Information shown shall include, but not be limited to, the following:

- North arrow and scale
- Street names and State Route designations
- Applicable notes
- Cable routings
- Cable size
- Underground or aerial cable use
- "Make Ready" pole charts where necessary
- Conduit installations
- Location of pull boxes
- Hub site locations with star modem
- Bridge crossings
- Right-of-way
- Match lines at each break in geometry
- Insets or details for areas where multiple cable runs enter or exit a cabinet or pull box
- Cross streets
- Dimensions from the edge of pavement to the conduit runs

- Driveway crossings
- Pole, lines
- Applicable bid item numbers
- Drop kits, known splice points and slack loops

2.4 Miscellaneous Elements and Special Situations

Existing equipment to be removed is covered by the *GDOT Standard Specifications - Construction of Transportation Systems*, Section 647.

Proposed traffic signs shall be shown using the appropriate symbol at the proposed location on the plan. The MUTCD sign number, where applicable, will be used to identify the sign. Overhead street name signs shall be shown and detailed on a summary of quantity sheet separate from the construction/installation plan sheets. Signs shall be included in the list of materials if they are to be paid for under the 647-1000 lump sum pay item. Otherwise, the 636-1032 Highway Sign pay item may be used to pay for signs.

Insets or details shall be used whenever adequate detail cannot be easily shown on the plan. This can occur due to scale limitations, excess clutter or various other reasons.
Occasionally, it may be necessary to show information that falls beyond the normal boundaries of the plan. In such cases, the items shall be shown using match lines or break lines. Whenever these methods are used, care shall be taken so that necessary information is not omitted.

Section 3
CONTRACT DOCUMENTS AND REVIEW

This section applies when signal plans are to be implemented in a stand-alone GDOT signal installation project. A complete bid package shall be prepared as described below.

3.1 Bid Packages

Bid packages shall consist of a complete plan set and special provisions that may be required. Plan sets shall consist of the following items:

- Cover sheet
- Revision summary and general notes sheet
- Summary of quantities sheet
- Overhead sign summary of quantities sheet
- Detailed estimate sheet
- Legend sheet
- Intersection plan sheets
- Communication plans
- Detailed drawings (if needed)
- Traffic signal detail sheets
- Signing and Pavement Marking Details (if needed)
- GDOT Standard Details & Construction Details
- Special Provisions (if needed)
- Cost estimate for entire signal package
- Cost estimates for lump sum traffic signal installations

See the GDOT Electronic Design Guidelines (EDG) for further details.

3.1.1 Cover Sheet

The Cover Sheet (as shown in the Appendix A) shall include the following:

- County name

- State Traffic Safety and Design Administrator and Chief Engineer of Record with approval signature lines
- Location and Design Approval Date
- Revision box
- Call before you dig symbol
- Consultant's name and address
- Consultant's PE seal and stamp (if consultant design)
- PI Number
- State Project Number
- Project description placed in the center portion of the sheet
- Percent in County(ies)
- Percent in Congressional District(s)
- Roadway Classification
- Level of Oversight
- Index of sheets, placed on upper left portion of sheet
- Vicinity map
- Mid Point Coordinates (if available)

The cover sheet shall be plotted on mylar for signature.

3.1.2 Revision Summary and General Notes Sheet(s)

All notes of a general nature and all items that are revised shall be listed on this sheet. The revisions shall be indexed by date and sheet(s) revised with a brief description of each revision. All revision dates listed on the revision summary shall be shown in the revision box on the Cover Sheet.

3.1.3 Summary of Quantities Sheet

The Summary of Quantities Sheet shall contain a summary of the signal related pay items by intersection, for the entire project. The traffic signal pay items shall be summarized in

a separate table. All items shown on the Summary of Quantities Sheet shall correspond to a pay item number that will be on the Detailed Estimate Sheet.

The traffic signal items summary shall list the lump sum signal installation and pole pay items arranged by intersection. The remaining pay items such as sidewalk, signs and markings, and communication items shall be summarized by sheet.

The signal installation will typically be a lump sum pay item that includes most of the measures necessary at a specific intersection. The lump sum pay item includes all signal heads, wiring, conduits, control equipment, cable, pull boxes and signs.

3.1.4 Detailed Estimate Sheet

The Detailed Estimate Sheet shall list each pay item used in the project arranged in numerical order. The pay items shown in the plans shall be consistent with the latest edition of the Pay Item Index. The estimated quantity for each pay item shall be provided and should match the Summary of Quantities Sheet except for nominal rounding to the next whole integer.

The layout of the Detailed Estimate Sheet should be arranged in accordance with the size of the project. For small projects, the pay items should read from left to right. For large projects, the orientation can be rotated so that pay items read from the bottom to the top of the sheet. A current pay item index is available from the Office of Contracts Administration and may also be available on the GDOT web page. (The current URL is http://www.dot.state.ga.us/dot/construction/contractsadm/bidreports.shtml, but this address is subject to change.)

3.1.5 Legend Sheet

The Legend Sheet shall contain the standard symbols used for traffic signal plans and communication plans. An example is contained in Appendix A. An electronic version of the legend in MicroStation format can be obtained from the GDOT Office of Traffic Safety and Design, Design Functions.

A legend will **not** be shown on the intersection plan sheets.

3.1.6 Intersection Plan Sheets

For each signalized intersection included in the plan set, two (or three) plan sheets shall be required, the Existing Conditions Sheet and the Construction/Installation Sheet(s). These sheets shall be prepared in accordance with the requirements of Section 2.2. When signal plans are being prepared as part of a roadway project that involves significant geometric changes, the existing conditions sheet is generally not required.

3.1.7 Communications Plans

When applicable, drawings shall be prepared to show the measures required for establishing communications with the signal controllers. Communications plans shall consist of an overall cable routing plan and more detailed Communications Plan Sheets. These sheets shall be prepared in accordance with the requirements of Section 2.3 of this document.

When a new communications cable is to be installed aerially and will not replace an existing cable, each pole shall be indicated on the drawing along with the proposed attachment height. The pole owner and identification number should also be shown. Anchors and guy wires will likely be required at the beginning and end points of an aerial run and when the angle between the cable and pole attachment point does not equal 90 degrees on either side of the attachment. Anchors and guy wires should be installed within the existing right of way. Final determination/approval for points of attachment and for guying shall be made by the Office of Utilities in conjunction with the utility (pole) owner(s).

If new communications cable is to be installed aerially and will replace existing communications cable at the same point of attachment, the number of poles, type of poles and distance between poles are the only items that need to be defined if the existing cable satisfies height and clearance standards. This will indicate what type of attachment hardware is required. The disposition of existing communication cable and messenger

cable should be determined by the existing cable owner and noted in the plans. The location of the connection to telephone service, or phone drop, shall be shown on the plans. The phone drop should be located on the same corner as the controller cabinet if possible. The location of all underground cable runs and conduit requirements shall also be shown.

3.1.8 Detail Drawings

All typical and special details that apply to the plans package in general, but are not covered by standard drawings (e.g. Traffic Signal Details), will appear in this portion of the plans. These details shall include communications cable entry details for access to controller cabinets. If a detail is specific to a certain intersection and cannot be shown legibly on the Intersection Plan Sheet, it shall appear on a plan sheet immediately following its Intersection Plan Sheet. GDOT traffic signal detail sheets may be available from the website.

3.1.9 Special Provisions

Special provisions shall include any modifications to existing standard specifications in *GDOT Standard Specifications - Construction of Transportation Systems*, latest edition and supplements thereto. The following topics will be included:

- General information and requirements
  - an overview describing the location, function and interrelationship of each major system element
  - an index to remaining specifications, critical construction schedules, special maintenance of traffic provisions, quality of materials and workmanship provisions, contractor's responsibilities and other appropriate provisions
- Section 687 "Traffic Signal Timing"
  - The special provisions shall contain a Section 687 to cover signal timing on systems that contain five or more signalized intersections. Signal timing shall be included on the Summary of Quantities sheet and as part of the Detailed Estimate using the 687-1000 pay item.

3.2 Additional Data

The following data shall accompany intersection plan sheets at final submittal:

- An inventory of all existing signal-related equipment
- Revised signal phasing, if necessary, as approved by GDOT
- All survey data obtained for the preparation of plans
- Cost estimate for each pay item
- Right-of-way documentation if applicable

3.3 Submittal/Review Process and Procedures

3.3.1 Field Reviews and Data Collection

Prior to beginning the actual design process, a field review shall be undertaken at each intersection included in the plans package. The primary purpose of this review is to establish design parameters and constraints for each intersection, to investigate each location for any special circumstances which may not have yet been established, and to generally familiarize the designer with each intersection. The extent of the field review will vary somewhat depending on the improvements. Those items that need to be checked and/or established for each intersection during the field review include:

- Electrical service points
- Controller location
- Existing signal pole locations
- Existing traffic signal heads (including pedestrian)
- Existing intersection geometry and pavement markings
- Inventory of controller cabinet
- Potential utility conflicts (aerial and underground)
- Joint use poles
- Special situations that affect design
- Curb ramps/crosswalks
- Communication cable routing and controller access
- Loops and pullbox locations
- Interconnect cable

3.3.2 Preliminary Field Plan Review (PFPR)

A PFPR will be required based upon the type of project (roadway, signal/system upgrade, isolated/developer). To be prepared for a PFPR, all preliminary intersection design work, including cabinet and pole locations, loops, and communications cable routing shall be complete. Also, right-of-way lines shall be located. Plan contents shall be in accordance with the PDP. Pay item numbers should be shown for each new item. The PFPR shall be requested in accordance with the GDOT PDP guidelines.

3.3.3 Final Field Plan Review (FFPR)

A FFPR meeting shall be requested in accordance with the GDOT PDP guidelines. Representatives from the appropriate offices within GDOT as well as the signal designer (GDOT and consultant) shall be present.

The purpose of the FFPR is to review the design plans at a final design stage and to ensure that any design changes resulting from a preliminary field plan review have been addressed. Basic design concept changes should not be made at the FFPR unless they are unavoidable.

At this point, the remaining required sheets should be submitted for review in addition to the communication cable routing and intersection plan sheets. This submittal shall consist of all elements of the plans package as defined in the PDP.

3.3.4 Final Submittal (Consultants only)

Once the final modifications resulting from the FFPR have been made, the plans package is ready for final submittal to the GDOT Office of Traffic Safety and Design. This submittal shall include one full-size set of bond plans (36 inches by 24 inches), one half-size set (18 inches by 12 inches), special provisions, final engineers estimate and a CD-ROM computer disc containing the CADD files (in MicroStation 2-D CADD format) used by the project (to include the final plan sheets, all displayed reference files and detailed estimate). Final plans submittal shall be in accordance with the GDOT PDP process.

Section 4

DESIGN STANDARDS

Intersection design elements shall conform to the following standards. For all items not specifically covered, the design standards listed in Section 1, INTRODUCTION, shall govern the design.

4.1 Signal Phasing

The standard phase numbering system as illustrated in Figure 4-1 shall be used to designate signal phases.

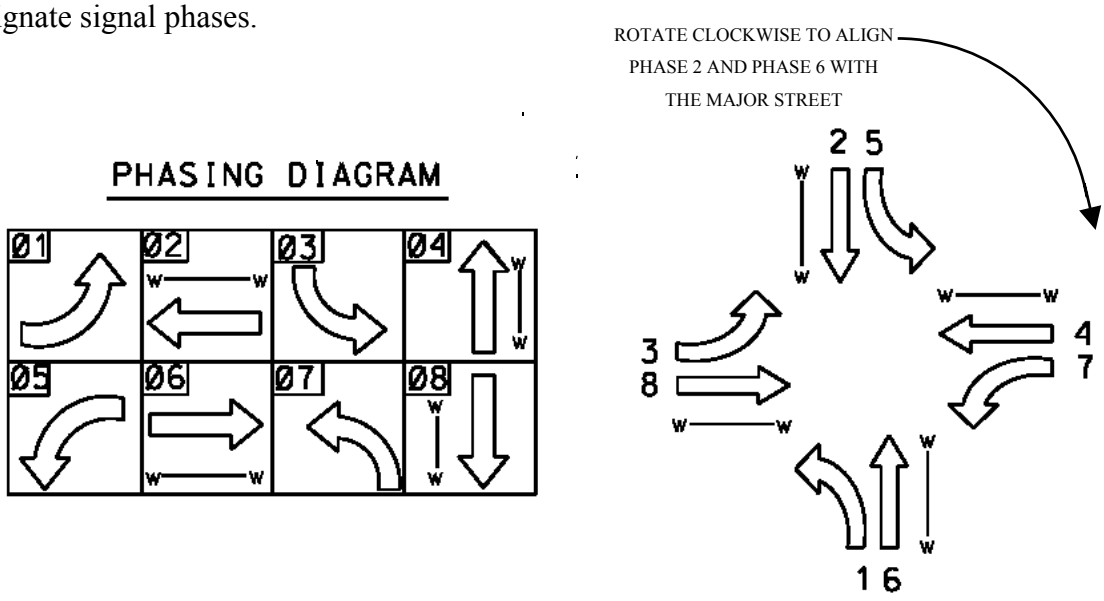

Figure 4-1 Phasing Orientation

In general, Phases 2 and 6 should be assigned to the through movements of the main street. The orientation of phases should be consistent within a signal system.

The above scheme for orienting phases provides uniformity. Note that the even numbered phases increase in the clockwise direction, starting from phase 2 at the 12 o'clock position. The odd numbered phases also increase clockwise starting from phase 1 at the 6 o'clock position. When the main street is oriented N-S, phase 6 serves the northbound approach. When the main street is oriented E-W, the diagram is rotated clockwise 90 degrees so that phase 6 serves the eastbound approach.

It should be noted that controllers have the capability for programming additional signal phases, for changing the sequence of phases, and for employing unique phase/ring structures. These capabilities may prove useful in special situations such as for diamond interchange control or for complex intersections. However, utilizing such features has implications with regards to field wiring, to the setup of input and output files, and to the programming of the conflict monitor. Therefore, when non-standard phasing/sequencing is necessary, it is extremely important to document the unique aspects of the special operation. A special phasing note shall be placed directly below the phasing diagram to provide more clarification (e.g., phases 4 and 8 do not operate concurrently - the side street is split-phased).

4.2 Vehicular Signals

The standard size for vehicular signal heads is 12 inch. LEDs are typically used for illumination of indications. Other applications may apply if approved by GDOT (ie. programmable).

4.2.1 Mounting

Signal heads should be placed for maximum visibility and clarity of meaning to the motorist. Pedestal-mounted signal heads may be used whenever adequate sight distance cannot be obtained with the span wire or mast arm mounted signal heads or when required to clarify control for a particular movement. Pedestal-mounted signal heads shall be used only as supplemental signal heads. When mast arms are used, signals shall be rigidly mounted to the mast arms.

4.2.2 Placement

Signal heads shall be located within the 20-degree cone of vision as specified in the MUTCD. Longitudinal placement shall be such that at least one signal head is located not less than 40 feet from the stop line but not greater than 150 feet. If signal heads cannot be placed within this range, then supplemental signal heads are required. The number and arrangement of supplemental signal heads is at the designer's discretion and shall be subject to GDOT approval.

4.2.3 Head Placement Guidelines

Appendix B shows examples of head placement to assist the designer in the lateral placement of heads with respect to lane lines. The examples also give guidelines for signal display and turn indication. The designer should keep in mind that these are examples and that engineering judgement should be used in each intersection design. The required signing and pavement marking associated with the different examples has not been shown and should be verified by the designer. Markings, such as crosswalks, may require that different signal head indications be used.

4.2.3.1 Guidelines For Channelized Left Turn Lanes with Wide Medians

When a left-turn lane is significantly separated from the through lanes, such as a channelized left turn lane in a wide median, it may be necessary to shift the signal head toward the middle of the channelizing island in order to maintain the required 20 degree cone of vision. This applies when the left turn lane is operated as a permissive left turn or a protected/permissive left turn. Figure 4-2 illustrates the geometric constraints for head placement over the outside edge of the through lanes. A five-section head is shown, but the constraints would also apply to placement of a three-section head.

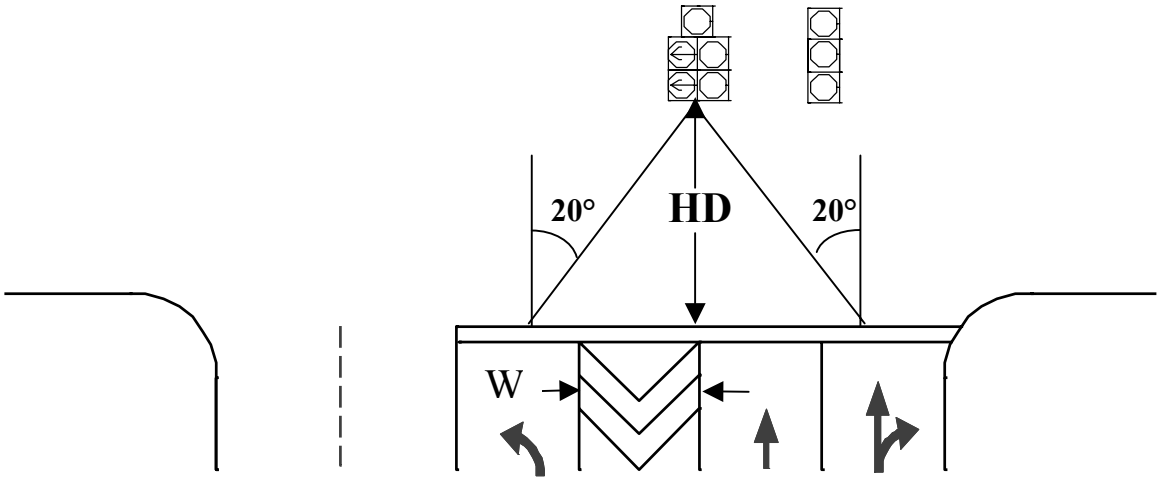

Figure 4-2 Signal Head/Left-turn Treatment

HD = Horizontal Distance From Stop Bar to Signal Heads (ft.)

W = Width of hatched out area between left turn lane and through lanes (ft.)

Table 4-1 indicates the geometric conditions for which the design can remain as shown above and in Figures 8A & 8C of Appendix B.

Table 4-1 Maximum Width of Hatched-Out Area So That the 20 Degree Cone is Maintained Without Shifting Signal Head

HD	W
40	8
50	12
60	16
70	19
80	23
90	26
100	30
110	34
120	37
130	41
140	44
150	48

When the width of the hatched-out area between the through lane and the left turn lane is greater than shown in the table above, it may be possible to revise the design to result in a greater horizontal distance to the signal heads. When that is not feasible, it then becomes necessary to laterally shift the five section head to the left into the hatched-out area, improving the cone of vision for the driver in the left turn lane. However, if the shift is too great, the cone of vision may not be adequate for the driver in the right most through lane. Figure 4-3 and Table 4-2 provide guidelines for shifting the signal head. Again, a five-section head is shown, but the guidelines would also apply to placement of a three-section head.

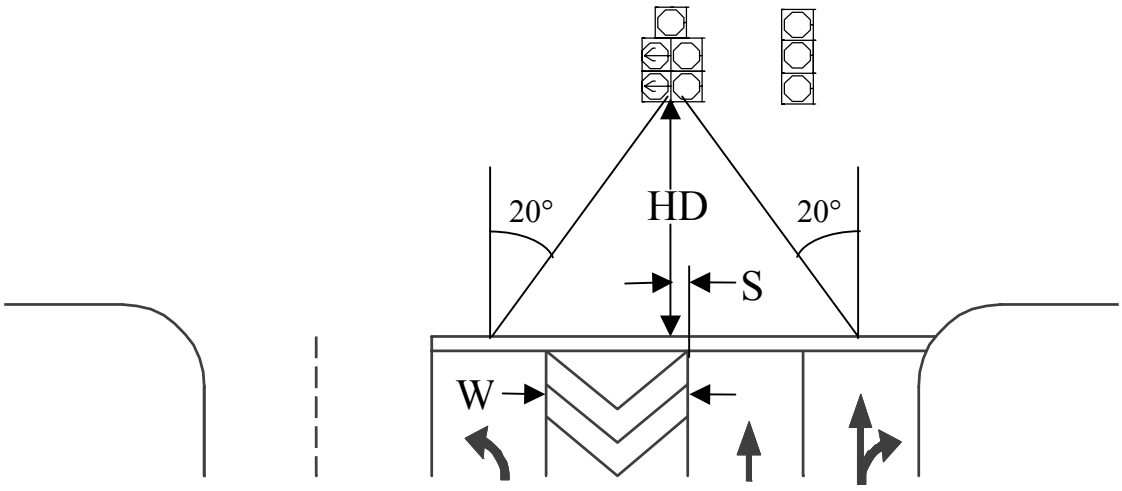

Figure 4-3 Left Turn Lane Signal Head Alignment

HD = Horizontal Distance From Stop Bar to Signal Heads (ft.)

W = Width of hatched out area between left turn lane and through lanes (ft.)

S = Distance the 3 or 5-Section Head should be moved to the left (ft.)

For combinations of HD and W not shown in Table 4-2, it is not possible to achieve the 20 degree cone of vision for both the left turn and the through lanes by simply shifting the position of the 3 or 5-section head. The solution would involve either an additional head or moving the longitudinal position of the heads.

4.2.4 Signal Head Equipment

Tunnel visors are normally used on each signal indication. When a signal head's indication is visible to a conflicting movement, louvered visors or optically programmable signal heads may be specified. Due to their high initial and maintenance costs, optically programmable heads should be used only when visibility of conflicting indications cannot be addressed by other means. When optically programmed heads are used, they shall be mounted in a manner that will minimize movement of the heads.

Table 4-2 Guidelines for Modifying Figures 8A & 8C, Appendix B
Required Lateral Shift of 3 or 5-Section Head

HD	W	S
50	<12	0
55	<16	0
55	16	2
60	<16	0
60	16	1
60	17	2
60	18	3
65	<18	0
65	18	1
65	19	2
65	20	3
65	21	4
65	22	5
70	<20	0
70	20<W<29	W-19
75	<22	0
75	22<W<31	W-21
80	<24	0
80	24<W<36	W-23
85	<25	0
85	25<W<38	W-24
90	<27	0
90	27<W<41	W-26
95	<29	0
95	29<W<45	W-28
100	<31	0
100	31<W<49	W-30
105	<32	0
105	32<W<49	W-31
110	<34	0
110	34<W<50	W-34

When an exclusive left-turn phase is used and permissive left turns are also allowed, a five-section signal head shall be specified in accordance with GDOT specifications.

Protected only left turn phases shall use three section signal heads with arrow indications in each section. Two heads shall be provided even when the turn bay consists of a single lane (see Appendix B for design guidelines).

Backplates should be installed as needed to reduce glare from the sun or confusion caused by competing background lighting. However, backplates also increase wind load on span-wires and mast-arms. The designer should contact the District Signal Engineer for guidance regarding the use of backplates at specific intersections.

4.2.5 Pre-emption

A traffic signal can be switched from its normal sequence of phases and intervals to a special phase/interval sequence in response to the assertion of a controller input designated for pre-emption. Typical applications include railroad pre-emption to help clear the tracks as trains approach and to omit track crossing signal phases when trains are present; and emergency vehicle pre-emption to assist emergency vehicle movements (e.g., at signals near fire stations).

4.2.5.1 Railroad Pre-emption

When signalized intersections are located near railroad at-grade crossings, consideration should be given to establishing pre-empt operation. Pre-emption provides benefits in both safety and operational efficiency.

The decision to effect pre-empt operation should consider the following factors:

- Frequency and duration of trains
- Volume of vehicular traffic at the crossing
- Distance to the crossing and the frequency of vehicular queues at the crossing
- The complexity of the signal phasing and whether opportunities exist to serve certain movements effectively during the period when trains are using the crossing

When railroad pre-emption is needed, it is necessary to interface the controller with the railroad detection/signaling equipment (usually maintained by the railroad company).

This involves a request to the railroad company and coordination with their signal department. In most cases, the railroad company will install a junction box at the edge of their right-of-way with an output from the train detection device.

Figure 4-4 shown below, is an example of a intersection signal phasing diagram with railroad preemption.

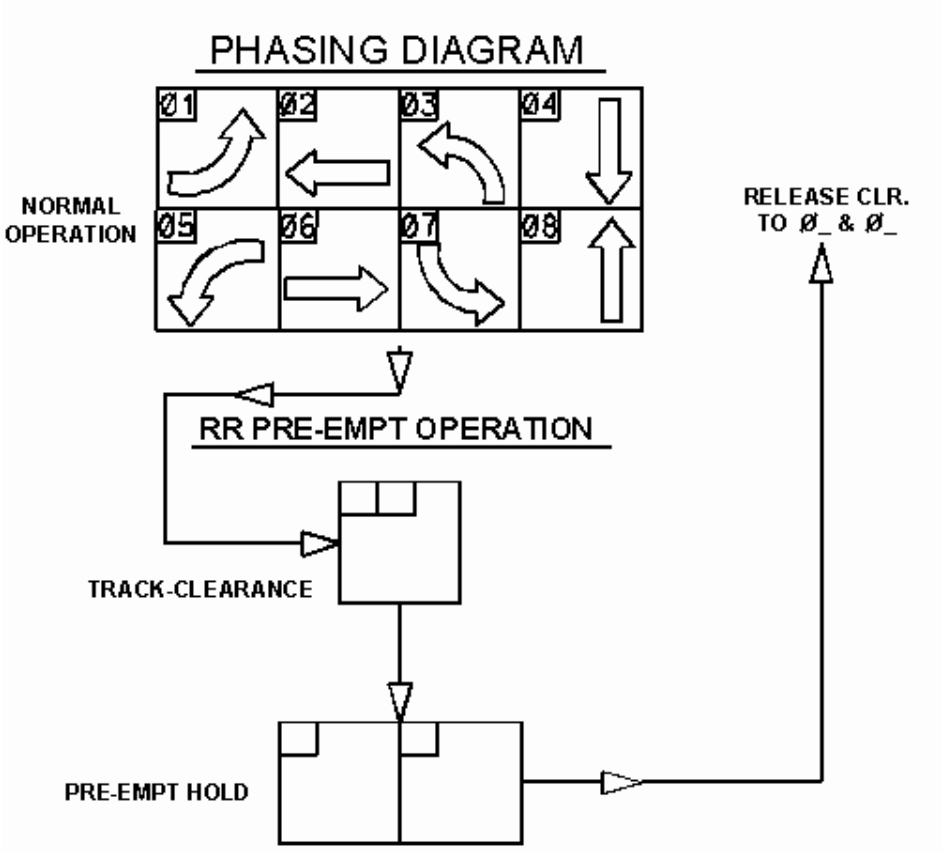

Figure 4-4 Sample Pre-emption Phasing Diagram

4.2.5.2 Emergency Vehicle Pre-emption

Pre-emption for emergency vehicles can be useful (normally in urban environments) in assisting emergency vehicles entering the traffic stream (e.g. near fire stations) and through areas likely to be blocked by normal traffic (e.g. on one-way streets). In contrast to railroad pre-emption, however, the potential operational and safety benefits for emergency vehicle pre-emption may not be obvious. Emergency vehicles share the road with normal traffic, are driven by trained/highly skilled operators, are capable of collision

avoidance maneuvers, and their operations usually have only momentary impact on traffic flow. In other words, as compared to safety issues at railroad grade crossings, the hazards posed by emergency vehicle operations are not as susceptible to correction by traffic signal pre-emption techniques.

The decision to effect pre-empt operation should consider the following factors:

- Frequency of emergency vehicle operations
- Inability of emergency vehicles to safely enter and move within the normal traffic stream
- The existence of consistent, predictable emergency vehicle routes
- Potential for disruption of normal traffic flow

Emergency vehicle pre-emption can be effected in a variety of ways. For example, for fire station signals, it may be possible to interface the controller pre-empt input with an output from the fire dispatch/communications equipment. There is also a variety of traffic signal mounted auxiliary devices available which can detect approaching emergency vehicles and assert the controller pre-emption input via specialized input file cards.

4.3 Pedestrian Signals & Poles

4.3.1 Pedestrian Considerations

Unless specifically accepted by the Office of Traffic Safety and Design, pedestrian signal heads, pushbuttons, crosswalks, landings, and curb ramps shall be provided for all approaches to an intersection. Specific exceptions might include situations where a pedestrian pathway or landing would be unsafe.

In such instances (where the Office of Traffic Safety and Design has issued an exception), it is acceptable to display the "NO PEDESTRIAN CROSSING" sign (R9-3a or R5-10c) and a supplemental sign indicating where the nearest pedestrian crossing is located (R9-3b). An example installation is shown below in Figure 4-5.

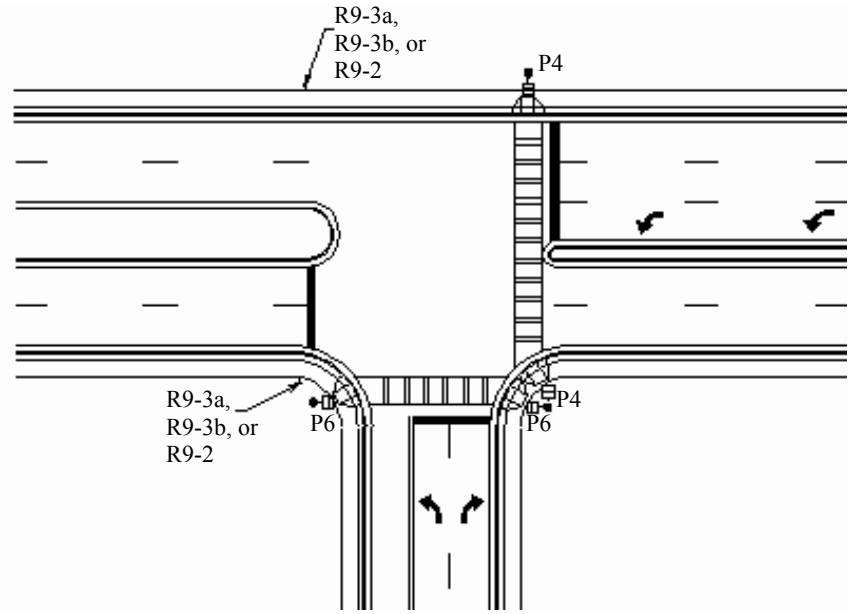

Figure 4-5 Pedestrian Crossing

Pedestrian pushbutton stations should be installed within ten inches of the sidewalk or landing. R10-3b signs shall be provided to indicate the direction of crossing associated with each pushbutton. When the signal poles cannot be located appropriately so that pedestrian heads and pushbuttons can be accommodated on the same poles, separate pedestal poles shall be provided. Care should be given to assure that pedestrian heads are visible through the entire length of the crosswalk.

In quadrants with large turning radii and raised islands, the standard practice shall be to install pedestrian signals and pushbutton stations (as well as the needed ADA standard curb ramps) inside the raised island, provided the island is of sufficient size. A crosswalk from the island to the curb shall be shown, but these movements will not be controlled by pedestrian signals. R560-5 signs (STOP FOR PEDESTRIANS IN CROSSWALK) shall be used at all signalized locations which have channelized islands and which include free flowing right turn lanes. These signs shall be located approximately 25 feet in advance of the crosswalk(s). Figure 4-6 shows a typical design.

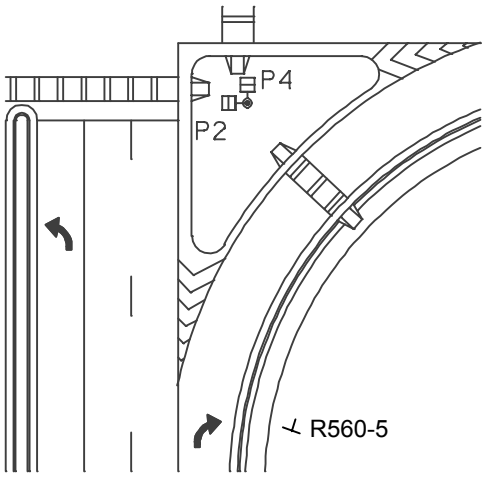

Figure 4-6 Typical Pedestrian Treatment At Right Turn Islands

4.3.2 Pedestrian Signal Heads

Eighteen inch LED pedestrian signal heads will be used, along with pole or post-mounted pedestrian detectors (pushbuttons) as necessary. Signage shall be added to define the pedestrian signal displays. Pushbutton assemblies will have an integral sign mount.

4.3.3 Curb Ramps

For each approach where crosswalks are provided, curb ramps meeting the provisions of the ADA shall be provided. In general, curb ramps should be designed with a separate ramp for each crosswalk, rather than one ramp in the center of the radius.

A concrete pad (meeting ADA landing area requirements) will be installed for each crosswalk approach where sidewalks do not exist. If curb and gutter exists, a curb ramp(s) will be installed. A paved path will be provided between the curb ramp and the pedestrian pushbuttons. The end of the paved path shall not be more than ten inches from the pedestrian pushbutton.

The current ADA Standard Detail Sheets are available (in MicroStation format) from GDOT's Office of Traffic Safety and Design. The ADA Standard Detail Sheets (as well as other GDOT Detail Sheets) may also be available from the GDOT website.

4.4 Poles

The general notes in the plan set shall require the contractor to submit pole and foundation calculations and shop drawings for review. The notes shall also contain requirements for future loading conditions that should be considered in the design.

The following are some examples of future loading conditions that should be considered in addition to the proposed design elements for pole and mast arm design calculations:

- A future new 5-section signal head located at the end of the mast arm
- A future 7-foot by 1.5-foot overhead street sign mounted between the through signal heads for each arm, if this sign is not included in the design
- 12-inch tunnel visors for each proposed and future signal head
- A future 2.5-ft by 3-ft regulatory sign mounted 1-foot from the end of each arm
- Back plates for each proposed and future signal head

Loading conditions should be considered on an individual basis, but the designer should consider opportunities for minimizing the number of different pole sizes used within a project (e.g., the designer could require all poles supplied to meet the project's maximum loading requirement).

4.4.1 Pole Placement

In general, traffic signal poles should be placed outside of the clear zone or as close to the back edge of the right-of-way as possible. Poles may be placed closer to the roadway when dictated by conditions, including the following:

- Presence of utilities lines
- When span wire mounting is used, it may be desirable to use a closer placement if a more suitable span configuration or better head placement can be achieved
- When designing mast arms, a closer location may be desirable to reduce arm lengths and to result in a more suitable head placement

When setting poles at a location other than at the back edge of right-of-way, the clear zone requirements of the *AASHTO Roadside Design Guide* shall be adhered to.

If the signal is being installed in urban conditions and a curb is present, then the absolute minimum horizontal clearance shall be 1.5 feet from the face of the curb to the face of the pole. (The typical standard is 12 feet from face of curb).

When the base roadway plans include a centerline and stationing, pole placement shall be indicated on the plans by station and offset.

4.4.2 Strain Poles

Traffic signal strain poles are specified as Type IV poles in accordance with Section 639 of the *GDOT Standard Specifications - Construction of Transportation Systems*. Strain poles can be made of either steel or concrete. If the type of material is not specified, the contractor may use either. All new poles at an intersection shall be of the same material and as specified in Section 639. When strain poles are to be installed, special attention must be given to foundation requirements and avoiding conflict with adjacent utilities, buildings, etc.

4.4.3 Timber Poles

The use of timber poles may be appropriate in cases where sufficient right of way is available to accommodate any needed down guys while maintaining clear zone requirements. Class II timber poles shall be used for signal spans. Class IV timber poles may be used only for installing aerial loop lead-in wire or communications cable.

4.5 Span Wire Configurations

Strain pole/span wire is the preferred support method for traffic signal installations for two reasons. Using span wire to support signal heads allows head placement in near optimal viewing position without overly restricting the placement of strain poles. It is also a more cost effective method than using mast arms.

There are several options for span wire configurations. Most common are the diagonal span, box span, modified box span and Z-span. These are described in detail in the *ITE Manual of Traffic Signal Design.* Other options are the H-span and X-span. Span wire configurations should be evaluated on an intersection basis in order to achieve optimal head placement while satisfying criteria for pole placement. The modified box design is the GDOT standard but others may be considered in special cases.

4.6 Mast Arm Configurations

Mast arm installations are most commonly used in urban or suburban locations. Although aesthetically pleasing, mast arm installations are typically more expensive than span wire. By its very nature, signal head positioning using mast arms is closely tied to pole placement, so pole positioning is a critical element in designing for mast arms. It is essential to evaluate intersection geometrics, underground utilities and available right-of-way to determine how a suitable signal head layout, meeting MUTCD alignment and setback standards, can be achieved using mast arms.

Mast arms can be mounted with either one arm or two arms per pole. Two arm poles are larger, but fewer poles are needed per intersection. Mast arms vary in length, but most are between 20 feet and 65 feet long. If long mast arms are to be used, consideration should be given to providing sufficient room to construct a large pole foundation. Mast arms should not be designed with signal heads located on the end of the arm to allow for shifts that may be necessary during installation. Mast arm lengths should be specified in increments of five feet.

4.7 Controller Equipment and Software

4.7.1 Model 2070 Family

Being modular in architecture, Model 2070 controllers can be built to be plug-compatible with either NEMA cabinets, 170 cabinets or (future) ITS cabinets. For new traffic signal installations (and for signal installations facing complete reconstruction) GDOT is

requiring that Model 2070L controllers be installed. Model 2070Ls are plug-compatible with cabinets built for Type 170 controllers.

4.7.1.1 Software

A traffic application software package has been licensed for statewide use by GDOT which provides the operational capability for both local signal control and for coordination among groups of Model 2070s using a variety of interconnection and system control methods.

GDOT also uses Eagle Traffic Control Systems ACTRA software. This PC/laptop based software contains database management and coordination functions and is capable of supervising field masters and isolated local 2070 controllers.

4.7.2 Controller Assemblies

A controller assembly consists of the controller, cabinet and the auxiliary equipment housed within the cabinet necessary to operate a traffic signal. The following sections describe GDOT specified items, which may be required in a controller assembly.

4.7.2.1 Cabinet

Cabinets for signal controllers shall be either Type 332, 336 or 336S. The primary cabinet used by GDOT is the 332 cabinet. It should be used in most cases where a ground mount cabinet is feasible. Where conditions require a more compact cabinet or a pole mounting, the 336 cabinet may be used.

Prefabricated bases shall be used for all new ground mounted cabinet installations. The 332 and 336 cabinet uses the same size base. Table 4-3 compares cabinet dimensions.

Table 4-3 CABINET DIMENSIONS

CABINET TYPE	HEIGHT (in.)	WIDTH (in.)	DEPTH (in.)
332	66	24	30
336	36	24	22
336S	46	24	22

4.7.2.2 Controller

Model 2070L controllers shall be used for all intersections. Phase assignments should follow the 8-phase diagram described in Section 4.1 to the greatest extent possible. Exceptions for special situations might include diamond interchange control and complex intersection geometrics. Unused or unnecessary phases shall be omitted.

4.7.2.3 Input File

Each traffic signal design shall include a diagram of the cabinet input file, which indicates the slots to be used and the types and functions of the cards to be installed.

To operate in actuated mode, a controller must receive information about traffic demand from detectors and pushbuttons in the field. The input file provides an isolated electrical path for those actuations and other inputs to enter the controller. An input file is a 19" tray, which holds up to 14, 2-channel isolator cards. Each input file slot and channel is wired to a specific pin in the Model 2070Ls C1 connector. Controller functions are standardly assigned to each input file slot and channel in order to provide for uniformity among intersections; however, the controller application software allows for redirection of inputs to other controller functions in order to accommodate unique intersection requirements. Table 4-4 (for 332 Cabinets) and Table 4-5 (for 336 Cabinets) show the input devices that are associated with the C1 input pins. The following abbreviations are used in the tables:

- TYPE –Indicates the slot's assigned input type (either DET, DC, AC or TBA)
  - DET – Reserved for vehicle detector inputs
  - DC – Reserved of low voltage input
  - AC – Reserved for 115 volt input
  - TBA (To Be Announced) – Available for user assignment
- Card – Type of Input Isolator (e.g. 2-CH or 4-CH Loop, DC Isolator, etc.)
- Function –This is the designation for the input hook-up. For example, L1 would designate the loop detector that is associated with phase 1.

There are two types of basic isolator cards – DC isolators and AC isolators. Both contain the simple electronics to isolate two field contact closures from controller input pins. DC isolators are typically used for pedestrian pushbutton inputs, remote vehicle detector inputs and other low voltage inputs. AC isolators are used for 115-volt inputs such as might be used for RR preempt operations or in hardwire interconnect systems. Additionally, more sophisticated electronic input cards are available in the marketplace.

The most common card is the loop detector (both 2-channel and 4-channel). Other special purpose cards include video detectors (I-VDS) and emergency vehicle preemption cards.

4.7.2.4 Modems

Several types of modems are available. The proper type should be specified depending on the type of system.

- Fiber Modems

  In systems using fiber optic interconnect cable (the method preferred by GDOT), a fiber modem is required at each controller. Fiber optic modems convert electronic data (controller I/O) to and from laser light for transmission over the fiber optic medium. Fiber optic modems shall be mounted within the cabinet but external to the controller.

- 6A or 6B Modems

  In systems using paired, copper interconnect cable (e.g. when updating controllers within an existing paired cable system), an internal modem can be used for communication. Model 2070 internal modems are designated 6A (for 1200 baud) and 6B (for 9600 baud) and one modem is required for each controller.

- Telephone Modems

  Telephone modems are used for communication between master controllers and the central office computer over dial-up telephone lines. One external telephone modem should be installed in each master cabinet. In some instances telephone modems are specified for communications with isolated local controllers.

Table 4-4 332 CABINET INPUT ASSIGNMENT*

	Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14
UPPER INPUT FILE (I)															
	Type	DET	DET	DET	DET	DET	DET	DET	DET	DET	TBA	TBA	DC	DC	DC
	Card														
Channel 1	CI Pin	56	39	63	47	58	41	65	49	60		80	67	68	81
	Function	L1	L2	L2	L2	L3	L4	L4	L4	L1			ϕ2 PED	ϕ6 PED	Flash
	Field Term	TB2 1,2	TB2 5,6	TB2 9,10	TB4 1,2	TB4 5,6	TB4 9,10	TB6 1,2	TB6 5,6	TB6 9,10			TB8 4,6	TB8 7,9	N/C
Channel 2	C1 Pin	56	43	76	47	58	45	78	49	62		53	69	70	82
	Function	L1	L2	L2	L2	L3	L4	L4	L4	L3			ϕ4 PED	ϕ8 PED	Stop Time
	Field Term	TB2 3,4	TB2 7,8	TB2 11,12	TB4 3,4	TB4 7,8	TB4 11,12	TB6 3,4	TB6 7,8	TB6 11,12			TB8 5,6	TB8 8,9	N/C

LOWER INPUT FILE (J)

	Type	DET	DET	DET	DET	DET	DET	DET	DET	DET	TBA	TBA	DC	DC	DC
	Card														
Channel 1	CI	55	40	64	48	57	42	66	50	59		54	71	72	51
	Function	L5	L6	L6	L6	L7	L8	L8	L8	L5			EV A	EV B	RR1
	Field Term	TB3 1,2	TB3 5,6	TB3 9,10	TB5 1,2	TB5 5,6	TB5 9,10	TB7 1,2	TB7 5,6	TB7 9,10			TB9 4,6	TB9 7,9	TB9 10,12
Channel 2	C1 Pin	55	44	77	48	57	46	79	50	61		75	73	74	52
	Function	L5	L6	L6	L6	L7	L8	L8	L8	L7			EV C	EV D	RR2
	Field Term	TB3 3,4	TB3 7,8	TB3 11,12	TB5 3,4	TB5 7,8	TB5 11,12	TB7 3,4	TB7 7,8	TB7 11,12			TB9 5,6	TB9 8,9	TB9 11,12

Table 4-5 336 CABINET INPUT ASSIGNMENT*

	Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Type	DET	DET	DET	DET	DET	DET	DET	DET	DET	TBA	TBA	DC	DC	DC
	Card														
Channel 1	C1 Pin	56	39	58	41	55	40	57	42	51	71	72	67	68	81
	Function	L1	L2	L3	L4	L5	L6	L7	L8	SE 1	EVA	EVB	ϕ2 Ped	ϕ6 Ped	Flash Sense
	Field Term	TB7 1,2	TB7 5,6	TB7 9,10	TB8 1,2	TB8 5,6	TB8 9,10	TB9 1,2	TB9 5,6	TB5 1,2	TB5 5,6	TB5 9,10	TB4 1,2	TB4 5,6	N/C
Channel 2	C1 Pin	47	43	49	45	48	44	50	46	52	73	74	69	70	82
	Function	L2	L2	L4	L4	L6	L6	L8	L8	R/R	EVC	EVD	ϕ4 Ped	ϕ8 Ped	Stop Time
	Field Term	TB7 3,4	TB7 7,8	TB7 11,12	TB8 3,4	TB8 7,8	TB8 11,12	TB9 3,4	TB9 7,8	TB5 3,4	TB5 7,8	TB5 11,12	TB4 3,4	TB4 7,8	N/C

*Note: Tables 4-4 and 4-5 indicate the type of input device that is to be inserted into each slot for a Type 332 and 336 cabinet. The detector cards are inserted in slots 1 through 8. Slots 9 through 11 in a 336 cabinet are used for railroad and emergency vehicle preemption if needed. Slot 9 is used for an additional detector card in a 332 cabinet and Slots 10 and 11 are for other equipment. Slots 12 through 14 are for DC isolators. Slots 12 and 13 are for DC isolators used to generate controller inputs from the contact closure created by activation of the pedestrian pushbuttons. Slot 14 will always contain a DC isolator that is used for flash sense and stop time. In a 332 cabinet, Slots 12 through 14 in the lower input file are used for railroad and emergency vehicle preemption.

4.7.3 Cabinet Placement

Base-mounted controller cabinets shall typically be installed. The orientation of the cabinet shall be specified on the plans. The cabinet shall be oriented such that maintenance personnel can view the signal faces while facing the controller. The cabinet should also be located on level terrain and near the back edge of right-of-way where practical. Avoid areas prone to collecting water.

A number of other factors should also be considered when locating the cabinet. In general, the controller cabinet should be located in the quadrant nearest to the power service point and telephone service point if applicable. Consideration should be given to minimizing the chances of the cabinet being struck by errant vehicles, maintenance equipment, etc. In addition, the cabinet should not obstruct the sidewalk, even when the doors are open. Care should be taken such that doors do not open off the right-of-way.

4.7.4 Power Disconnect

A power disconnect box shall be installed for each intersection. The disconnect box allows the power to the cabinet to be cut off in the event that a signal installation is damaged and live wires are on the ground. For aerial power service feeds, the disconnect box should be located near the top of the signal pole that is adjacent to the controller cabinet. For underground power service feeds, the disconnect box should be located on the utility pole from which the power service is drawn.

4.8 Detectors

The preferred method of detecting vehicles at traffic signals is the inductive loop detector. Other technologies may be used in circumstances where loops are infeasible (e.g. on bridge decks) or impractical (e.g. poor pavement conditions). In such circumstances, a possible alternate technology is video detection (I-VDS) as specified in Special Provision Section 938 of the *GDOT Standard Specifications - Construction of Transportation Systems*, available from the GDOT Office of Transportation Safety and Design.

All loops should be wired to unique detector channels, even though they may be on the same approach and input to the same phase. Separate saw cuts should be used for loop lead-ins. Loops should be shown with loop wire coming out of a corner, not between corners. Where possible, saw cuts for lead-ins (and associated Type 1 pull boxes) should be located to avoid areas susceptible to damage from truck traffic (e.g. in the corner radius). Typically, loop lead-ins should be installed underground in 2-inch conduit if feasible; however, if it becomes necessary to cut paved surfaces or bore under driveways, the designer may use aerial methods to provide for lead-in installation.

4.8.1 Presence Detectors

All left-turn detectors and, in most cases, all side street detectors will use presence loops. All presence loops shall be of quadrupole design with dimensions of 6' by 40'. Side street loops will typically be installed with the leading edge 2' past the front of the stop bar.

4.8.2 Volume Density

When operating speeds on the major roadway exceed 35 mph, volume density operation should be used for the through movements. All detectors for volume density operation shall use 6' by 6' loops.

Loops on high-speed approaches shall be located so as to provide dilemma zone protection. The dilemma zone is an area in which drivers are uncertain of the proper response to a yellow signal indication. By locating the loop at the upstream boundary of the dilemma zone, the passage timer can be reactivated before a vehicle enters the area of uncertainty. The dilemma zone boundaries are defined by a leading edge at five seconds of travel time from the intersection to a trailing edge located at approximately two or three seconds from the intersection. Therefore, a three second passage time would extend the green indication until the driver is beyond the dilemma zone.

Table 4-6 shows the location of setback detectors for high-speed approaches. If these distances cannot be achieved due to an obstruction such as a bridge, the loops should

generally be located further from, rather than closer to the intersection. Appropriate passage timing should be programmed so that the green is extended sufficiently to take drivers from the loop to a distance of two seconds travel time from the intersection. Additional factors that can influence detector placement include sight distance and horizontal and vertical alignment of the roadway.

Table 4-6 SET-BACK DETECTOR PLACEMENT

Posted Speed Limit, miles per hour	Detector Set-back Distance, feet
35	260
40	300
45	330
50	370
55	410
60	440
65	480

4.8.3 Call Loops

In some cases, the signal designer may choose to provide detectors that place a call to a phase but do not extend the green. An example where call loops might be used is in conjunction with setback loops described in the previous section. Because driveways may be located between the loops and the stop line, volume density phases are frequently operated with minimum recalls activated. If a call loop were placed near the stop line, then the recall would not be needed.

The designer should use judgement in selecting the proper size for call loops that will suit the application. In the example described above, a 6’ x 20’ loop would be adequate.

4.8.4 Queue Loops

Another type of detector that is available to the designer for application in special cases is the queue detector. An example of a common application is freeway off-ramps where long queues may cause a safety concern. The designer must decide how the queue detector is to be implemented. One method would be to locate a 6’ x 6’ loop at a selected location on the ramp. The detector should have some amount of delay to insure that

vehicles are queued (5 to 10 seconds depending on location). The input of the queue detector could be assigned to pre-empt. Of course, the pre-empt sequence should be programmed to provide the desired change in signal operation.

4.8.5 System Sensors

The SE-MARC (closed loop) master control software currently used by GDOT is capable of operating in a traffic responsive mode. The software uses a thresholding algorithm as the basis for timing plan selection. The level of volume (and occupancy) is used to select cycle length, and volume differentials are used to select both the offset relationship (inbound vs. outbound) and the split relationship (main street vs. side street). User adjustable parameters determine the thresholds for switching between timing plans.

Traffic responsive mode can only work effectively if the master controller has access to traffic flow data that is representative (or even predictive) of conditions within the system. Therefore, selecting locations for system sensors is critical. Important references to assist in this process include *FHWA Guidelines for System Sensor Placement* and *Locating Detectors for Advanced Traffic Control Strategies,* (Report No. FHWA-RD-75-91), 1975.

The traffic application software package allows system sensors (normally 6' x 6' loops) to be routed to local controller cabinets and terminated at unused input file slots. That is, the local controller software can assign detectors to "System Sampling Function" and therefore report the collected data to the master controller periodically. It should be noted that the local controller software allows local (phase) detectors to be given dual use as system sensors.

4.9 Communications Equipment

The guidance in the following section is basic and limited to fiber optic cable design issues for closed loop signal systems - typically used on arterials in suburban (and sometimes rural) environments. An expanded discussion of fiber optic cable design issues is available in *Section 3* of the *GDOT NaviGAtor ATMS Design Manual.*

Communications between the master controller and local controllers will be through a user-owned fiber optic cable. Each cable run will be assessed to determine the size of cable to be installed. The minimum cable size is 24 fibers. All fiber cables shall be single mode. Fiber optic communication cables may be run overhead or in underground conduit.

One slack loop shall be provided between signalized intersections that are less than 1000 feet apart. Two slack loops shall be evenly spaced between intersections spaced greater than 1000 feet. For underground systems, Type 5 pull boxes are required at locations where splices will be made. Type 4 or Type 5 pull boxes are required for slack loops and coils. Type 3 pull boxes may be used for pull through with a note stating no coils or slack loops.

A fiber optic drop cable (six fibers) is used to connect the modem in the controller cabinet to the fiber trunk cable. Drop cables shall be spliced to the trunk either in an aerial closure or in an underground closure in a Type 5 pull box.

In fiber optic communication systems, the intersections are connected together in daisy-chain fashion with each fiber modem acting as repeater. At any intersection where cable runs must extend in more than two directions, a star modem must be provided.

4.10 Wiring, Conduit and Pull Boxes

4.10.1 Wiring Standards

Wiring standards (installation and material) for signal heads, pedestrian heads, pedestrian pushbuttons and loop detectors are defined in Sections 647 and 925 of the *GDOT Standard Specifications - Construction of Transportation Systems.*

When the signal cabinet is located less than ten feet from a signal pole, all conduits from that signal pole should be routed directly into the cabinet base. A pull box should not be

used. All other conduits will be routed to a pull box adjacent to the cabinet and then routed into the cabinet base.

Detector loops shall be run to a pull box located behind the edge of pavement within 75 feet of the edge of the loop. At that point, the loop wire shall be spliced to shielded cable, which shall be run to the controller. Three pair shielded cable shall be used for all detector lead-ins.

The GDOT standard requires a separate 7-conductor cable run to each approach that has signal heads. In addition, a 7-conductor cable shall be run to serve the pedestrian signals on each corner where pedestrian signals are provided.

Power service shall be provided using a 2 -conductor cable.

4.10.2 Conduits and Pull Boxes

Pull boxes are available in a variety of sizes and types ranging from Type 1 (smallest) to Type 5 (largest). A detailed explanation about the appropriate use of each type of pull box can be found in the Traffic Signal Details, along with sizes and placement specs. In general, Type 1 pull boxes are used where loop wire is spliced into shielded lead-in cable. Type 1 pull boxes may also be used where only one or two small cables enter the box. Type 2 pull boxes are used for junction boxes at poles and pedestals. Type 3 (or larger) pull boxes are used in front of controller cabinets (to accommodate multiple runs of conduits and cable routing). Type 4 and Type 5 pull boxes are used where fiber-optic cable is routed to accommodate bending radius requirements. Type 4 pull boxes are used for underground slack loops and Type 5 pull boxes are used to house splice closures.

To a great extent, pull box usage and conduit routing should be tailored to existing conditions. For instance, it is desirable to provide separate pull box and conduit systems for signal field wiring (115 volt), pedestrian detector and loop detector homerun cable (low voltage) and communications cable (FO). It is also desirable to limit the number of different pull box types that are used at an intersection by standardizing on the largest

pull box needed. This may be possible in rural areas, where right-of-way is abundant and conflicts with existing utilities are minimal. On the other hand, in more developed areas,

limited right-of-way and utility conflicts may force compromises.

Existing conduit and pull boxes may be used wherever possible if in usable condition and the pull boxes are large enough to accommodate the cable. Multiple conduits installed in the same trench should be labeled on the plans.

The maximum length of conduit between pull boxes for fiber optic cable is 750 feet. Conduit for copper interconnect or loop lead-ins should not contain runs over 250 feet between pull boxes.

Power service and telephone drops shall be installed in separate pull boxes and conduits. Signal cables shall be installed in separate conduits, but they can be run into the same pull box used for loop cables. Loop lead-ins, pedestrian pushbutton cables, and communication cables may be installed in the same conduit; however, it is preferred to isolate communications cable from loop lead-in and pedestrian pushbutton cables.

All conduits placed under roadways shall be rigid or type 3 depending on area conditions. All placement of cable, conduit and pull boxes will be in accordance with the *National Electric Code*, latest edition.

In general, the following conduit sizes shall be used:

- Loop Lead-Ins – 2-inch
- Signal Cable – 2-inch, but 3-inch or 4-inch may be used depending on the number of cables in the conduit
- Fiber optic Cable (24 fiber single mode) – 2 inch
- Power Service – 1-inch (Rigid)
- Spare Conduit – 2 inch
- Telephone service – 1 inch

Tables 4-7 and 4-8 provide guidelines for determining the size and number of conduits required.

Table 4-7 CABLE AREA

Cable Type	Approximate Area in Square Inches
3 Pair Shielded (14 AWG)	0.28
7 Conductor (14 AWG)	0.17
24 Fiber, Single Mode, Cable	0.17

Table 4-8 CONDUIT FILL CAPACITY

	Fill Area (Square Inches)			
Conduit Diameter (Inches)	1”	2”	3”	4”
25 % (Desirable)	0.22	0.84	1.85	3.18
40 % (Maximum)	0.34	1.34	2.95	5.09

4.11 Traffic Signal Related Signs and Pavement Markings

Traffic signs and pavement markings will be specified according to the GDOT Signing and Pavement Marking Guidelines.

The need for signing and pavement markings will be considered for each intersection individually. There are certain general principles that must always be considered in the application of signing and pavement markings. All signing and pavement marking installations should:

- Fulfill a specific need
- Command the attention of drivers
- Convey a clear, simple meaning
- Allow the driver an adequate response time

4.11.1 Signs

Typical sign installations will be post-mounted in accordance with the MUTCD. Certain special situations may warrant the installation of overhead signing. The following is a list of situations that may warrant the installation of overhead signing in lieu of a post-

mounted sign, but each individual occurrence must be properly studied and GDOT concurrence received before a final determination is made.

- Traffic volumes at or near capacity
- Complex intersection and/or signalization design
- Three or more traffic lanes in each direction
- Restricted sight distance
- Closely spaced intersections
- Multi-lane turns
- High percentage of truck traffic
- Very high travel speeds
- Insufficient space for ground signs
- Dropping a through lane as a turn-only lane

With the exception of street name signs, the number of signs located on signal spans shall be minimized.

4.11.2 Overhead Street Name Signs

Overhead street name signs shall be designated as D-Spec signs. The designation shall also contain a sequentially increasing number to denote each sign. For example, the first street name sign shall be designated as D-Spec #1. The street name sign for the next different street shall be D-Spec #2, etc. For example, D-Spec #1 could have the name of the main street and D-Spec #2 would then have the name of the side street.

D-Spec signs shall use eight inch, D series letters. The sign shall be 18 inches high with a variable width depending on the legend and margins with a maximum width of 10 feet. The width shall be to the nearest half foot, i.e. 8 feet, 6 inches, not 8 feet, 4 inches. Margins shall be 4-inch minimum and can be increased by ½ inch increments so that the width is to the nearest half foot. Arrows shall be 9 inches long with a 6-inch space between the arrow and street name.

Overhead street name signs should generally be mounted above the approach the signs are intended for. When the width of the sign does not affect the proper placement of signal heads, the sign should be mounted between the two signal heads. Overhead street name signs should be mounted perpendicular to the approach lanes. When the configuration of signal spans or mast arms are such that street name signs would not be perpendicular if attached thereto, it may be desirable to attach the street name sign to the signal pole.

4.11.3 Pavement Markings

If pavement markings are required, they will typically be specified to include an area 100 feet back from the stop bar. When necessary, pavement markings will be extended to greater distances in order to complete the design. Pavement markings will be added to both major and minor street approaches, as required. All pavement markings will typically be thermoplastic. Pavement marking design will be based on the latest standard details.

Reflective pavement markers shall be installed per GDOT standards. Installation of typical pavement markings, such as lane lines, directional arrows, etc., shall be in accordance with GDOT standards.

Appendix A

Example Plan Set

STATE	PROJECT NUMBER	SHEET NUMBER	TOTAL SHEETS
GA.		1	XX

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

TRAFFIC OPERATION IMPROVEMENTS
COUNTY/CITY
PROJECT NUMBER
FEDERAL AID PROJECT
P.I. NO. 123456

STATE ROUTE NO.
FEDERAL ROUTE NO.

INDEX	
SHEET NO.	DESCRIPTION
1	PROJECT COVER
2	REVISION SUMMARY AND GENERAL NOTES SHEET
3-4	SUMMARY OF QUANTITIES SHEETS
5	DETAILED ESTIMATE SHEET
6	LEGEND SHEET
7-10	INSTALLATION PLAN SHEETS
11	COMMUNICATION ROUTING SHEET
12-13	COMMUNICATION PLANS
	GEORGIA STANDARD DETAIL SHEETS
XX	TRAFFIC SIGNAL DETAIL SHEETS TS-01-TS-11
XX	ADDITIONAL STANDARD DETAIL SHEETS AS NEEDED

NOTE:
ALL REFERENCES IN THIS DOCUMENT, WHICH INCLUDES ALL PAPERS, WRITINGS, DOCUMENTS, DRAWINGS, OR PHOTOGRAPHS USED, OR TO BE USED IN CONNECTION WITH THIS DOCUMENT, TO "STATE HIGHWAY DEPARTMENT OF GEORGIA", "STATE HIGHWAY DEPARTMENT", GEORGIA STATE HIGHWAY DEPARTMENT", "HIGHWAY DEPARTMENT", OR "DEPARTMENT" WHEN THE CONTEXT THEREOF MEANS THE STATE HIGHWAY DEPARTMENT OF GEORGIA, MEAN, AND SHALL BE DEEMED TO MEAN THE DEPARTMENT OF TRANSPORTATION.

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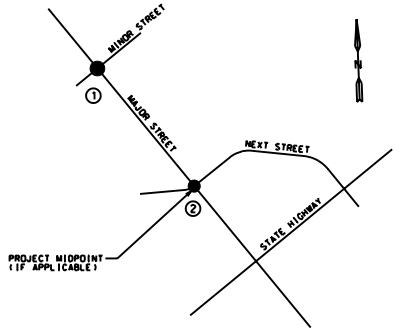
INTERSECTION LOCATIONS

1. MINOR STREET AT MAJOR STREET
2. NEXT STREET AT MAJOR STREET



LOCATION MAP

PLANS SUBMITTED BY:

STATE TRAFFIC SAFETY AND DESIGN ADMINISTRATOR

DATE CHIEF ENGINEER

IF YOU DIG GEORGIA...
CALL US FIRST!
1-800-282-7411
(770) 623-4344
(METRO ATLANTA ONLY)
UTILITIES PROTECTION CENTER
IT'S THE LAW

LOCATION AND DESIGN APPROVAL DATE: _____

THE DATA, TOGETHER WITH ALL OTHER INFORMATION SHOWN ON THESE PLANS, OR IN ANY WAY INDICATED THEREBY, WHETHER BY DRAWINGS OR NOTES, OR IN ANY OTHER MANNER, ARE BASED UPON FIELD INVESTIGATIONS AND ARE BELIEVED TO BE INDICATIVE OF ACTUAL CONDITIONS, HOWEVER, THE SAME ARE SHOWN AS INFORMATION ONLY, ARE NOT GUARANTEED, AND DO NOT BIND THE DEPARTMENT OF TRANSPORTATION IN any WAY. THE ATTENTION OF THE BIDDER IS SPECIFICALLY DIRECTED TO SUBSECTIONS 102.05, AND 104.03 OF THE SPECIFICATIONS.

URBAN ARTERIAL
FULL FHWA OVERSIGHT

THIS PROJECT IS LOCATED:
100% IN THIS COUNTY
100% IN CONGRESSIONAL DISTRICT 99

PLANS COMPLETED	
REVISIONS	

STATE	PROJECT NUMBER	SHEET NUMBER	TOTAL SHEETS
GA.		2	XX

REVISION SUMMARY SHEET

DATE	REVISED SHT. NO.	REVISION

TRAFFIC SIGNAL GENERAL NOTES

1. THE COMPLETE SIGNAL INSTALLATION SHALL CONFORM TO ALL APPROPRIATE PARTS OF THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES CURRENT EDITION, INCLUDING SUBSEQUENT PUBLISHED RULINGS.
2. SIGNAL HEADS SHALL BE ERECTED TO PROVIDE AT LEAST 17 FEET BUT NO MORE THAN 19 FEET CLEARANCE FROM BOTTOM OF SIGNAL HEADS TO TOP OF ROAD SURFACE AND A MINIMUM OF 8 FEET MEASURED HORIZONTALLY BETWEEN CENTERS OF SIGNAL FACES.
3. SHIELDED CABLE WILL BE USED FOR DETECTOR RUNS AS SHOWN ON THE DETAIL SHEET. DETECTORS SHALL HAVE SEPERATE LEAD-INS TO THE CONTROL CABINET.
4. THE CONTRACTOR SHALL LOCATE UNDERGROUND UTILITIES IN VICINITY OF NEW TRAFFIC SIGNAL POLES BEFORE INSTALLATION. MINOR SHIFTS (UP TO A MAXIMUM OF 5 FEET) IN LOCATION OF NEW SIGNAL POLES, AT THE DISCRETION OF THE ENGINEER, ARE ACCEPTABLE TO AVOID UNDERGROUND UTILITIES. MINIMUM CLEARANCES FROM EDGE OF PAVEMENT SHALL BE MAINTAINED. PLACEMENT OF THE SIGNAL HEADS SHALL BE RETAINED AS SHOWN ON THE PLANS.
5. THE CONTRACTOR SHALL MAINTAIN EXISTING TRAFFIC SIGNALS DURING CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL TRAFFIC SIGNAL AND/OR CONTROL SYSTEM ADJUSTMENTS, INCLUDING TEMPORARY SUPPORT POLE LOCATION(S) REQUIRED BY THE PROJECT DURING THE INTERIM PERIOD THROUGH INSTALLATION OF NEW SIGNAL EQUIPMENT. AT NO TIME SHALL THE CONTRACTOR CAUSE ANY PART OF THE SIGNAL OPERATION TO BE INOPERABLE.
6. THE CONTRACTOR WILL BE RESPONSIBLE FOR ALL NEW GUYS ON EXISTING UTILITY TIMBER POLES WHEN ATTACHING SPAN WIRE OR INTERCONNECT CABLE TO THE POLES UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
7. INSTALLATION IS TO BE CHECKED AND ACCEPTED BY THE DISTRICT TRAFFIC ENGINEER PRIOR TO FINAL ACCEPTANCE.
8. WHEN REMOVED, EXISTING EQUIPMENT SHALL BE DELIVERED BY THE CONTRACTOR TO THE DEPARTMENT OF TRANSPORTATION OFFICE OF TRAFFIC OPERATIONS DISTRICT SIGNAL SHOP. CONTACT THE DISTRICT SIGNAL ENGINEER AT **********.
9. FOR STRAIN POLE FOUNDATION SIZE AND REINFORCEMENT. SEE STRAIN POLE AND MAST ARM POLE FOUNDATION SHEET.
10. MATERIAL CERTIFICATION IS REQUIRED PRIOR TO BEGINNING ANY SIGNAL INSTALLATION WORK. THE CONTRACTOR SHALL FOLLOW PROCEDURES OUTLINED IN THE SPECIFICATION.
11. THE INSTALLATIONS SHALL BE CAPABLE OF "CLOSED LOOP" ISOLATED MONITORING OVER TELEPHONE LINES FROM EXISTING CENTRAL COMPUTERS LOCATED AT BOTH THE LOCAL DOT DISTRICT OFFICE, TRAFFIC ENGINEERING SECTION, AND THE DOT OFFICE OF TRAFFIC OPERATIONS ELECTRICAL FACILITIES, 935 E. CONFEDERATE AVENUE BLDG. 5 ATLANTA, GEORGIA 30316. CLOSED LOOP SYSTEM DEMONSTRATION IS REQUIRED AT BOTH CENTRAL SITES, NOTED PRIOR TO FINAL ACCEPTANCE
12. ALL EXISTING STOP BARS AND CROSSWALKS THAT ARE NOT REMOVED OR RELOCATED SHALL BE REPAINTED.
13. PROPOSED SIGNAL SUPPORT WIRE ATTACHMENT HEIGHTS ON POLES ARE PROVIDED AS GENERAL GUIDELINES TO INSTALLER. ACTUAL ATTACHMENT HEIGHTS SHALL BE FIELD DETERMINED BY INSTALLER TO PROVIDE REQUIRED SIGNAL HEAD MOUNTING HEIGHTS AND CLEARANCE FROM EXISTING UTILITIES.
14. SAWCUTS AND REMOVAL OF ALL CONCRETE ASSOCIATED WITH CURB CUT RAMPS SHALL BE INCLUDED IN THE SIDEWALK PAY ITEM.
15. THE CONTRACTOR SHALL REPLACE IN KIND AND SIZE, AT NO SEPARATE EXPENSE TO THE DEPARTMENT, ANY BARRIER WALL, FENCE, DITCH PAVING, CURBING, SIDEWALK, GUTTER, SLOPE PAVEMENT, SIGNS, GUARDRAIL, LANDSCAPING, GRASSING, UTILITY SERVICE LINES, STORM DRAIN PIPES, MASONARY WALLS AND PAVING THAT IS REMOVED, DAMAGED OR DESTROYED.
16. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY AND ALL PERTINENT EROSION CONTROL. THESE MEASURES SHALL BE IMPLEMENTED AND MAINTAINED FOR THE DURATION OF THE WORK. THE CONTRACTOR SHALL CONSIDER THIS WORK INCIDENTAL TO THE OVERALL WORK BEING PERFORMED AND SHALL INCLUDE HIS COST FOR COMPLETING THIS WORK IN THE OVERALL BID SUBMITTED.
17. ANY TRAFFIC MARKING, SYMBOLS OR STRIPING TO BE REMOVED SHALL BE PAID FOR IN THE TRAFFIC CONTROL LUMP SUM ITEM.
18. NOTICE OF INTENT (NOI) IS NOT REQUIRED FOR THIS PROJECT.
19. THE PROJECT LIES WITHIN THE AREA INFESTED BY THE IMPORTED FIRE ANT. THE CONTRACTOR SHALL CONDUCT OPERATIONS IN ACCORDANCE WITH SECTION 155.

UTILITY OWNERS	
FACILITY	OWNER
ELECTRIC	
PHONE	LIST ALL UTILITY OWNERS
GAS	THAT WILL BE AFFECTED
CABLE	BY THE PROJECT
WATER	
SEWER	
RAILROAD	

NOTES:

1. UTILITY DISCLAIMER: EXISTING UTILITY LINES SHOWN ARE APPROXIMATE LOCATIONS ONLY. THE CONTRACTOR / INSTALLER SHALL FIELD VERIFY ALL EXISTING UTILITY LINE LOCATIONS PRIOR TO ANY CONSTRUCTION. DAMAGE TO EXISTING UTILITY LINES RESULTING FROM THE CONTRACTORS / INSTALLERS NEGLIGENCE SHALL BE REPAIRED AT THE CONTRACTORS / INSTALLERS EXPENSE.
2. CONTRACTOR / INSTALLER SHALL CONTACT UTILITY LOCATOR SERVICE, 1-800-282-7411, & CITY/COUNTY OF _____, **********. PRIOR TO ANY CONSTRUCTION.
3. EXISTING POLE ATTACHMENT DATA IS APPROXIMATE AND IS PROVIDED AS A GENERAL GUIDELINE TO THE CONTRACTOR / INSTALLER TO AID IN IDENTIFYING POTENTIAL INSTALLATION CONFLICTS. THE CONTRACTOR / INSTALLER SHALL PROVIDE APPROPRIATE CLEARANCES FROM UTILITIES.

SIGNING GENERAL NOTES

1. ALL STANDARD HIGHWAY SIGNS SHALL BE FABRICATED AND ERECTED IN ACCORDANCE WITH THE DETAILS SHOWN IN THE PLANS, THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, CURRENT EDITION, AND THE GEORGIA STANDARD SPECIFICATIONS, SUPPLEMENTAL SPECIFICATIONS, AND/OR SPECIAL PROVISIONS.
2. SIGN ERECTION LOCATIONS ARE APPROXIMATE AND MAY BE ADJUSTED TO MEET FIELD CONDITIONS WHERE NECESSARY, BUT SHALL BE WITHIN THE LIMITATIONS SET FORTH IN THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, CURRENT EDITION. NO SIGN LOCATION SHALL BE CHANGED BY THE CONTRACTOR OR BY THE PROJECT ENGINEER WITHOUT PRIOR APPROVAL FROM THE OFFICE OF TRAFFIC OPERATIONS.
3. ALL STANDARD HIGHWAY SIGNS SHALL BE ERECTED AT A HEIGHT OF 7 FEET ABOVE THE NORMAL EDGE OF PAVEMENT TO THE BOTTOM OF THE SIGN OR ASSEMBLY.
4. HORIZONTAL CLEARANCE FOR STANDARD HIGHWAY SIGNS ON ALL OTHER ROADWAYS SHALL BE 6 FEET FROM THE EDGE OF THE PAVED SHOULDER OR 12 FEET FROM THE NORMAL EDGE OF PAVEMENT TO THE NEARER EDGE OF THE SIGN(S), WHICHEVER IS GREATER. THE HORIZONTAL CLEARANCE IN NON-MOUNTABLE CURB SECTIONS SHALL BE AT LEAST 2 FEET FROM THE CURB FACE TO THE NEARER EDGE OF THE SIGN(S).
5. TYPE III (ENCAPSULATED LENS) REFLECTIVE SHEETING SHALL BE USED FOR ALL STANDARD HIGHWAY SIGNS REQUIRING REFLECTORIZED BACKGROUNDS EXCEPT AS SPECIFIED BELOW OR SPECIFIED OTHERWISE IN THE PLANS. EITHER CLASS 1 OR CLASS 2 ADHESIVE BACKING IS PERMISSIBLE.
6. TYPE VI (WIDE ANGLE PRISMATIC) REFLECTIVE SHEETING SHALL BE USED FOR ALL RED SERIES SIGNS (R1-1, R1-2, R1-3A, R1-4A, R5-1).

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	NAME		NAME
DESIGNED BY		DRAWN BY	
CHECKED BY		CHECKED BY	

DATE	REVISIONS	DATE	REVISIONS

GEORGIA DEPARTMENT OF TRANSPORTATION

REVISION SUMMARY AND GENERAL NOTES

STATE	PROJECT NUMBER	SHEET NUMBER	TOTAL SHEETS
GA.		3	XX

SUMMARY OF TRAFFIC SIGNAL ITEMS		TRAFFIC SIGNAL INSTALLATION	CONCRETE SIDEWALK, 6IN	CONCRETE CURB & GUTTER 6IN X 30IN,TP2	STRAIN POLE, TP IV	THERMOPLASTIC SOLID TRAFFIC STRIPE, 8IN WHITE	CONDUIT, RIGID, 1IN	CONDUIT, RIGID, 2IN	CONDUIT, NONMETAL TP 3, 2 IN.	FIBER OPTIC EXTERNAL TRANSCEIVER, DROP AND REPEAT, 1310 SINGLE MODE
LOCATION	SIGNAL INST. NO.	LUMP	SQ YD	LIN FT	EACH	LIN FT	LIN FT	LIN FT	LIN FT	EACH
MAJOR STREET AND MINOR STREET	8	LUMP	20	69	4	1340	50	75	810	1
TOTAL		LUMP	20	69	4	1340	50	75	810	1

SUMMARY OF FIBER OPTIC NETWORK SYSTEM							
ITEM	STEEL WIRE STRAND CABLE, 1/4IN	CONDUIT, NONMETAL, TP 3, 2IN	OSP FIBER OPTIC CABLE, LOOSE TUBE, SINGLE MODE, 24 FIBER	OSP FIBER OPTIC CABLE, DROP, SINGLE MODE, 6 FIBER	FIBER OPTIC CLOSURE, AERIAL(SEALED), 24 FIBER	FIBER OPTIC SPLICE, FUSION	FIBER OPTIC SNOW SHOE
SHT. NO.	LIN FT	LIN FT	LIN FT	LIN FT	EACH	EACH	EACH
11	1880	70	2275	210	1	8	5
TOTAL	1880	70	2275	210	1	8	5

TRAFFIC CONTROL- PROJECT NO. 123456
LUMP

TRAFFIC SIGNAL TIMING- PROJECT NO. 123456
LUMP

GRADING COMPLETE- PROJECT NO. 123456
LUMP

TESTING (COMMUNICATIONS)
LUMP

NOTE TO DESIGNER:
ITEMS MAY BE ADDED OR DELETED AS NEEDED

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ATLANTA, GEORGIA 30309
PH. 404-355-4010 FAX 404-355-0604

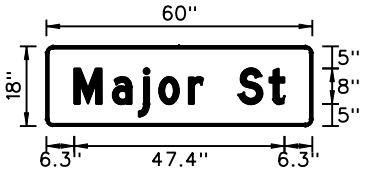
	NAME		NAME
DESIGNED BY		DRAWN BY	
CHECKED BY		CHECKED BY	

DATE	REVISIONS	DATE	REVISIONS

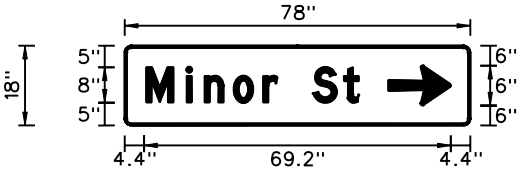
GEORGIA
DEPARTMENT OF TRANSPORTATION
SUMMARY OF QUANTITIES
MAJOR ST. AT MINOR ST.
INTERSECTION NO.

STATE	PROJECT NUMBER	SHEET NUMBER	TOTAL SHEETS
GA.		4	XX

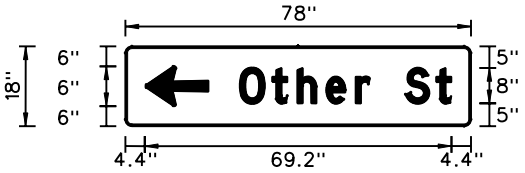
DETAILS & SUMMARY OF QUANTITIES - OVERHEAD STREET NAME SIGNS
MOUNTED ON TRAFFIC SIGNAL SPAN WIRES



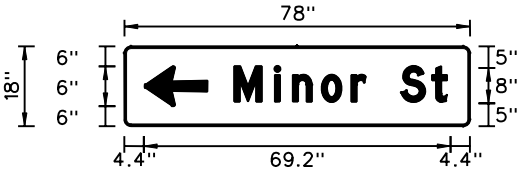
D-SPEC. #1
2 EA. REQ'D



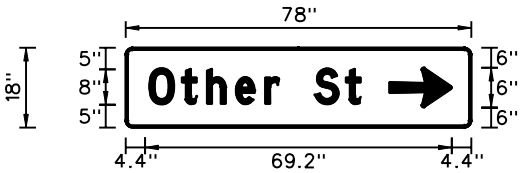
D-SPEC. #2
1 EA. REQ'D



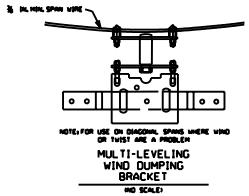
D-SPEC. #3
1 EA. REQ'D



D-SPEC. #4
1 EA. REQ'D



D-SPEC. #5
1 EA. REQ'D



NOTE: MINIMUM OF TWO HANGERS PER STREET NAME SIGN

ALL LETTERS TO BE 8 IN. U.C. & 6 IN. L.C. SERIES "D".
ALL ARROWS TO BE 6 IN. TALL & 9 IN. LONG.

BORDER SHALL BE ½ IN.
RADIUS SHALL BE 1-1/2 IN.

SIGN PANELS SHALL BE FABRICATED OF ONE CONTINUOUS PIECE OF ALUMINUM. SPLICING OF ALUMINUM PANEL SHALL NOT BE PERMITTED.

ALL SIGNS SHALL BE WHITE REFLECTORIZED LEGEND AND BORDER ON STANDARD INTERSTATE GREEN REFLECTORIZED BACKGROUND.

SUMMARY

LOCATION	SIGNS-TYPE 2 MAT'L (.10) REFL SHEETING, TP 6			
	CODE	SIZE	QUAN.	SQ.FT.
INSTALLATION NO. 1				
MAJOR ST. AT	D-SPEC. #1	60" X 18"	2	15.00
MINOR ST./OTHER ST.	D-SPEC. #2	78" X 18"	1	9.75
	D-SPEC. #3	78" X 18"	1	9.75
	D-SPEC. #4	78" X 18"	1	9.75
	D-SPEC. #5	78" X 18"	1	9.75
TOTALS				54.00

GRAY-CALHOUN & ASSOCIATES, INC.
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SUITE 200
ATLANTA, GEORGIA 30309
PH. 404-355-4010 FAX 404-355-0604

	NAME		NAME
DESIGNED BY		DRAWN BY	
CHECKED BY		CHECKED BY	

DATE	REVISIONS	DATE	REVISIONS

GEORGIA
DEPARTMENT OF TRANSPORTATION
OVERHEAD STREET NAME SIGNS

STATE	PROJECT NUMBER	SHEET NUMBER	TOTAL SHEETS
GA.		5	XX

DETAILED ESTIMATE SHEET

ITEM CODE NO.	DESCRIPTION	UNIT	QUANTITY
150-1000	TRAFFIC CONTROL (PROJECT NUMBER)	LUMP	LUMP
441-0106	CONC. SIDEWALK, 6 IN	SQ YD	20
441-6022	CONC CURB & GUTTER, 6 IN x 30 IN, TP 2	LIN FT	69
639-2001	STEEL WIRE STRAND CABLE, 1/4 IN	LIN FT	1880
639-4004	STRAIN POLE, TP IV	EACH	4
653-1804	THERMOPLASTIC SOLID TRAF STRIPE, 8 IN WHITE	LIN FT	1340
682-6110	CONDUIT, RIGID, 1 IN	LIN FT	50
682-6120	CONDUIT, RIGID, 2 IN	LIN FT	75
682-6233	CONDUIT, NONMETL, TP 3, 2 IN	LIN FT	880
687-1000	TRAFFIC SIGNAL TIMING (PROJECT NUMBER)	LUMP	LUMP
935-1113	OUTSIDE PLANT FIBER OPTIC CABLE, LOOSE TUBE, SINGLE MODE, 24 FIBER	LIN FT	2275
935-1511	OUTSIDE PLANT FIBER OPTIC CABLE, DROP, SINGLE MODE, 6 FIBER	LIN FT	210
935-3203	FIBER OPTIC CLOSURE, AERIAL (SEALED), 24 FIBER	EACH	1
935-4010	FIBER OPTIC SPLICE, FUSION	EACH	8
935-5060	FIBER OPTIC SNOWSHOE	EACH	5
939-1162	FIBER OPTIC EXTERNAL TRANSCEIVER, DROP AND REPEAT, 1310 SINGLE MODE	EACH	1
935-8000	TESTING	LUMP	LUMP

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	NAME		NAME
DESIGNED BY		DRAWN BY	
CHECKED BY		CHECKED BY	

DATE	REVISIONS	DATE	REVISIONS

GEORGIA
DEPARTMENT OF TRANSPORTATION
DETAILED ESTIMATE

STATE	PROJECT NUMBER	SHEET NUMBER	TOTAL SHEETS
GA.	0030701	6	XX

EXISTING UTILITIES

- EXISTING GUY WIRE
- EX.OH ELECTRIC
- EX POWER POLE
- EX TRANSFORMER
- EX.UG ELECTRIC
- EX GAS LINE
- EX GAS METER (GM)
- EX GAS VALVE (GV)
- EX WATER LINE
- EX FIRE HYDRANT (FH)
- EX WATER METER (WM)
- EX WATER VALVE (WV)
- EX SANITARY SEWER
- EX SS MANHOLE
- EX TELEPHONE MH
- EX OH TELEPHONE
- EX TELEPHONE POLE
- EX UG TELEPHONE
- EX OH CABLE TV
- EX UG CABLE TV
- EX STORM DRAIN
- EX CATCH BASIN
- EX DROP INLET
- EX SD MANHOLE

EXISTING SIGNAL

- CONTROLLER CABINET
- STRAIN POLE
- TIMBER POLE
- DOWN GUY
- MAST ARM
- STREET LIGHT
- 3 SECTION HEAD
- 5 SECTION HEAD
- OVERHEAD SIGN
- PEDESTAL POLE
- PED SIGNAL HEAD
- CURB CUT RAMP
- PULLBOX,TP 1
- PULLBOX,TP 2
- PULLBOX,TP 4
- PULLBOX,TP 5
- 6x6 PULSE LOOP
- 6x18 CALL LOOP
- 6x40 PRESENCE LOOP (DIPOLE)
- 6x40 PRESENCE LOOP (QUADRUPOLE)
- CONDUIT
- RAILROAD CONTROLLER
- SIGN POST

PROPOSED SIGNAL

- CONTROLLER CABINET
- STRAIN POLE
- TIMBER POLE
- DOWN GUY
- MAST ARM
- STREET LIGHT
- 3 SECTION HEAD
- 3 SECTION HEAD W/ BACKPLATE
- 5 SECTION HEAD
- 5 SECTION HEAD W/ BACKPLATE
- OVERHEAD SIGN
- PEDESTAL POLE
- PED SIGNAL HEAD
- CURB CUT RAMP - (See ADA Detail)
- PULLBOX,TP 1
- PULLBOX,TP 2
- PULLBOX,TP 3
- PULLBOX,TP 4
- PULLBOX,TP 5
- 6x6 PULSE LOOP
- 6x18 CALL LOOP
- 6x40 PRESENCE LOOP (DIPOLE)
- 6x40 PRESENCE LOOP (QUADRUPOLE)
- CONDUIT
- RIGID CONDUIT
- RAILROAD CONTROLLER
- SIGN POST

PROPERTY AND EXISTING R/W LINE	BEGIN LIMIT OF ACCESS.....BLA
REQUIRED R/W LINE	END LIMIT OF ACCESS.....ELA
CONSTRUCTION LIMITS	LIMIT OF ACCESS
EASEMENT FOR CONSTRUCTION & MAINTANENCE OF SLOPES	R/W AND LIMIT OF ACCESS
EASEMENT FOR CONSTR OF SLOPES	
EASEMENT FOR CONSTR OF DRIVES	

NOTE:
ITEMS CAN BE ADDED OR DELETED AS NEEDED.

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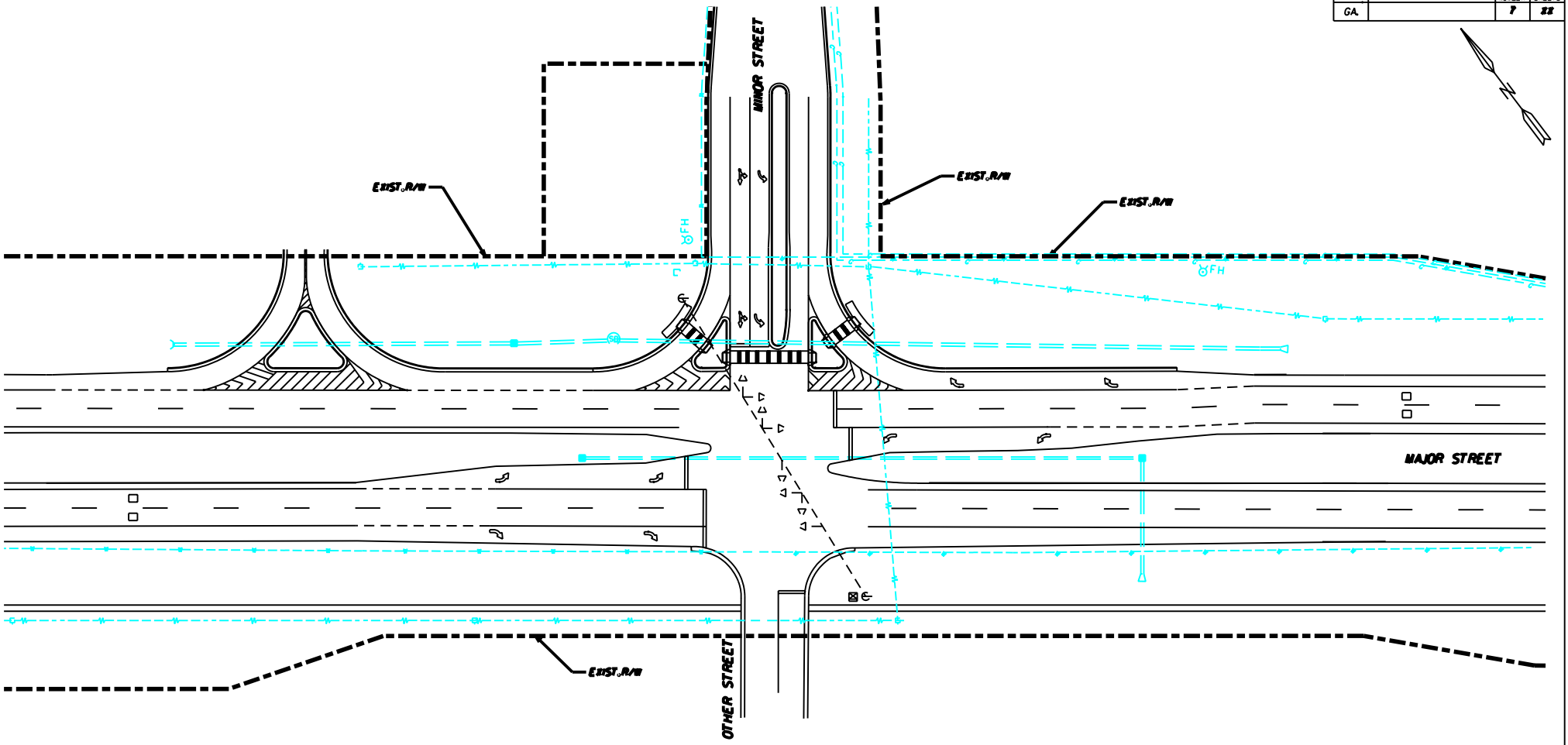
DESIGNED BY	NAME	DRAWN BY	NAME
CHECKED BY		CHECKED BY	

DATE	REVISIONS	DATE	REVISIONS
NOV 2002	DELETED SYMBOL FOR PROPOSED CURB CUT RAMP		
	ADDED NOTE FOR CURB CUT RAMP		
	ADDED NEW PED SIGNAL		
	ADDED RIGID CONDUIT		

LEGEND SHEET

STATE	PROJECT NUMBER	SHEET NUMBER	TOTAL SHEETS
GA.		7	22



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1800 PEACHTREE STREET, NW
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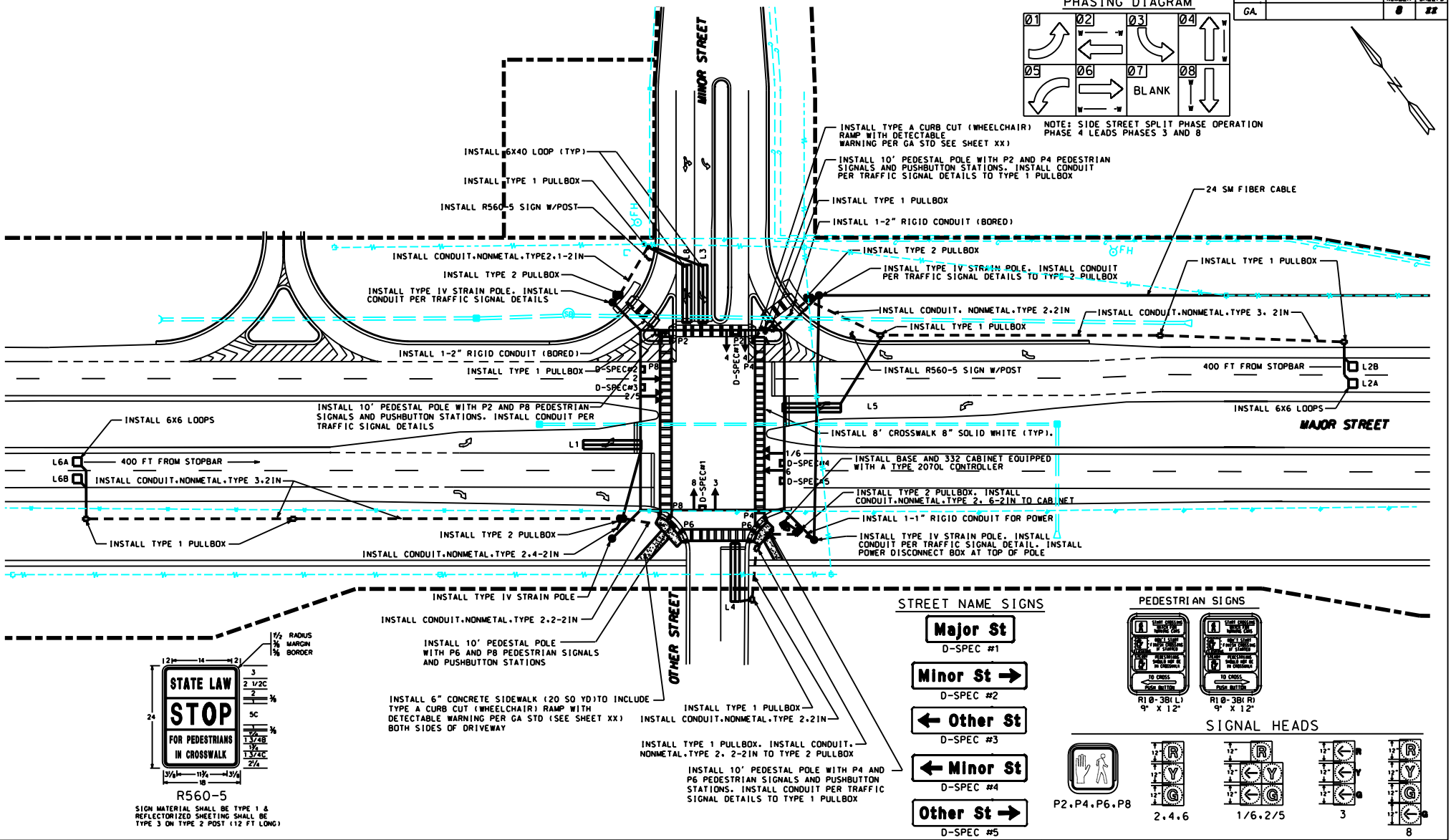
SCALE: 1" = 30'

DESIGNED BY	NAME	DRAWN BY	NAME
CHECKED BY		CHECKED BY	

DATE	REVISIONS	DATE	REVISIONS

GEORGIA
DEPARTMENT OF TRANSPORTATION
EXISTING CONDITIONS
MAJOR ST. AT MINOR ST.
INTERSECTION NO.

STATE	PROJECT NUMBER	SHEET NUMBER	TOTAL SHEETS
GA.		8	XX



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1800 PEACHTREE STREET.NW
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SCALE 1" = 30'

DESIGNED BY	NAME	DRAWN BY	NAME
CHECKED BY		CHECKED BY	

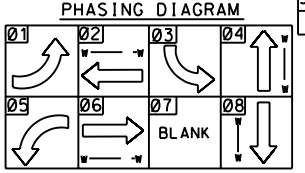
DATE	REVISIONS	DATE	REVISIONS

GEORGIA
DEPARTMENT OF TRANSPORTATION
CONSTRUCTION/INSTALLATION PLAN
MAJOR ST.AT MINOR ST.
INTERSECTION NO.

LIST OF MATERIALS

MATERIALS	UNIT	QUANTITY
CONTROL CABINET ASSEMBLIES		
A. CONTROLLER UNIT, MODEL 2070L	EACH	1
D. CABINET ASSEMBLY, MODEL 332	EACH	1
E. SWITCH PACK	EACH	8
F. DC ISOLATOR	EACH	3
G. LOOP DETECTOR, 2 CHANNEL	EACH	7
J. CONFLICT MONITOR, EXTENDED FEATURES	EACH	1
LOOP/PED LEAD-IN WIRE (SHIELDED, TWISTED/1000 FT)		
A. 3 PAIR, 18AWG	REEL	4
SIGNAL CABLE (14 AWG)		
B. 7 CONDUCTOR PER 1000 FT.	REEL	3
LOOP DETECTION WIRE (14 AWG, STRANDED/1000FT.)	REEL	2
ONE WAY, 3 SECTION, 12" LED SIGNAL HEAD, PLASTIC	EACH	5
ONE WAY, 4 SECTION, 12" LED SIGNAL HEAD, PLASTIC	EACH	1
ONE WAY, 5 SECTION, 12" LED SIGNAL HEAD, (CLUSTER) PLASTIC	EACH	2
18" PEDESTRIAN LED SIGNAL HEAD, SIDE BY SIDE	EACH	8
PEDESTRIAN PUSH BUTTON AND SIGN	EACH	8
BACK PLATE FOR ONE-WAY 3-SECTION, 12" SIGNAL HEAD	EACH	2
BACK PLATE FOR ONE-WAY 5-SECTION, CLUSTERED 12" SIGNAL HEAD	EACH	2
HARDWARE FOR SPANWIRE ERECTION	EACH	4
HARDWARE FOR PEDESTAL ERECTION FOR 18" PEDESTRIAN SIGNAL HEADS, TWO-WAY MOUNTING	EACH	4
PEDESTAL POLE 10'	EACH	4
CONDUIT, NONMETAL, TYPE 2, 2"	LIN FT	80
PULL BOX, TP 1, POLYMER CONCRETE	EACH	10
PULL BOX, TP 2, POLYMER CONCRETE	EACH	4
LOOP SAW CUT	LIN FT	800
R560-5 W/POST	EACH	2
MISC MATL TO COMPLETE INSTALLATION	LUMP	LUMP

PHASING DIAGRAM



NOTE: SIDE STREET SPLIT PHASE OPERATION
PHASE 4 LEADS PHASES 3 AND 8

STATE	PROJECT NUMBER	SHEET NUMBER	TOTAL SHEETS
GA.		9	##

332 CABINET INPUT ASSIGNMENT

SLOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14

UPPER INPUT FILE

	TYPE	DET	DET	DET	DET	DET	DET	DET	DET	DET	10A	10A	DC	DC	DC
	CARD	2-CHANNEL	2-CHANNEL			2-CHANNEL	2-CHANNEL						DC 150	DC 150	DC 150
CHANNEL 1	CI PIN	56	39	63	47	58	41	65	49	68		68	67	68	81
	FUNCTION	L1	L2A			L3	L4						02 PED	06 PED	FLASH
	FIELD TERM	182 1,2	182 5,6	182 9,10	184 1,2	184 5,6	184 9,10	186 1,2	186 5,6	186 9,10			188 4,6	188 7,9	N/C
	CI PIN	55	43	76	47	58	45	78	49	62		53	69	70	82
CHANNEL 2	FUNCTION		L2B										04 PED	08 PED	SPARE
	FIELD TERM	182 3,4	182 7,8	182 11,12	184 3,4	184 7,8	184 11,12	186 3,4	186 7,8	186 11,12			188 5,6	188 8,9	N/C

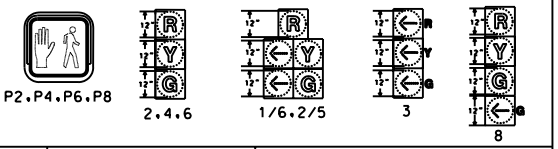
LOWER INPUT FILE

	TYPE	DET	DET	DET	DET	DET	DET	DET	DET	DET	10A	10A	DC	DC	DC
	CARD	2-CHANNEL	2-CHANNEL				2-CHANNEL								
	CI PIN	55	48	64	48	57	42	65	58	54		54	71	72	51
CHANNEL 1	FUNCTION	L5	L6A				L8								
	FIELD TERM	183 1,2	183 5,6	183 9,10	185 1,2	185 5,6	185 9,10	187 1,2	187 5,6	187 9,10			189 4,6	189 7,9	189 11,12
	CI PIN	55	44	77	48	57	45	79	58	63		75	73	74	52
CHANNEL 2	FUNCTION		L6B												
	FIELD TERM	183 3,4	183 7,8	183 11,12	185 3,4	185 7,8	185 11,12	187 3,4	187 7,8	187 11,12			189 5,6	189 8,9	189 11,12

PAY ITEMS

647-1000	TRAFFIC SIGNAL INSTALLATION NO. 1	LUMP	LUMP
441-0106	CONC. SIDEWALK, 6 IN	SQ YD	20
441-6022	CONC CURB & GUTTER, 6 IN x 30 IN, TP 2	LIN FT	69
639-4004	STRAIN POLE, TP IV	EACH	4
653-1804	THERMOPLASTIC SOLID TRAFFIC STRIPE, 8 IN WHITE	LIN FT	1340
682-6110	CONDUIT, RIGID, 1 IN	LIN FT	50
682-6120	CONDUIT, RIGID, 2 IN	LIN FT	75
682-6233	CONDUIT, NONMETAL, TP 3, 2 IN	LIN FT	810
939-1162	FIBER OPTIC EXTERNAL TRANSCEIVER, DROP AND REPEAT, 1310 SINGLE MODE	EACH	1

SIGNAL HEADS



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SCALE: 1" = 30'

	NAME		NAME
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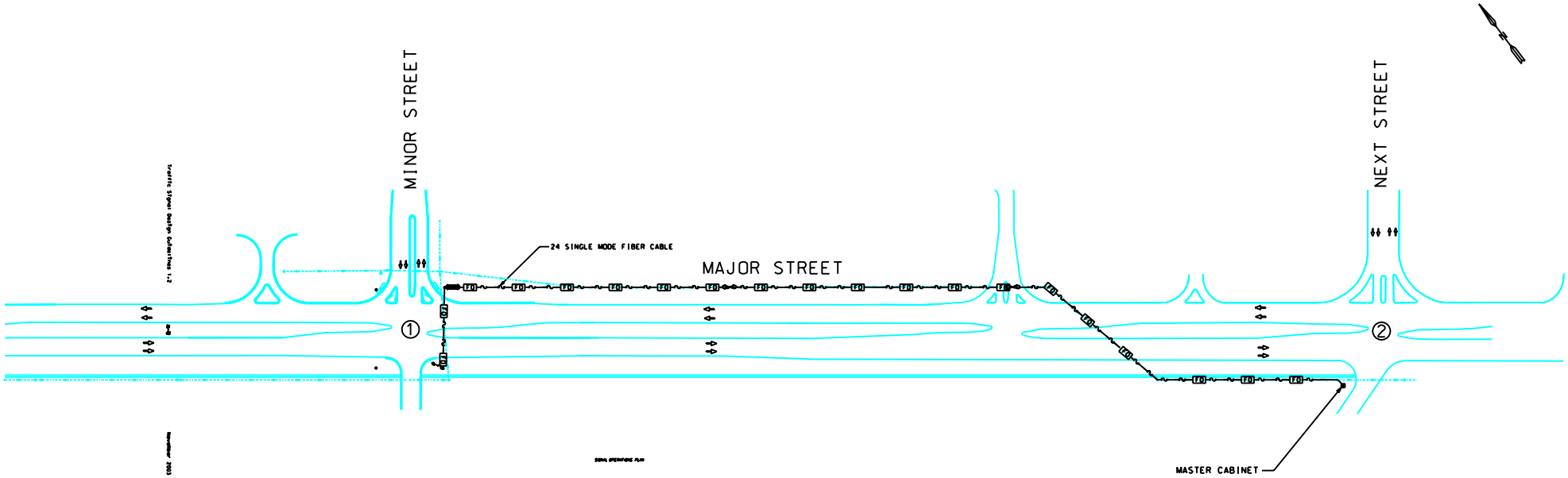
DATE	REVISIONS	DATE	REVISIONS

GEORGIA
DEPARTMENT OF TRANSPORTATION
SIGNAL OPERATIONS PLAN
MAJOR ST. AT MINOR ST.
INTERSECTION NO.

STATE	PROJECT NUMBER	SHEET NUMBER	TOTAL SHEETS
GA.		11	XX



COMMUNICATIONS LEGEND

- PROPOSED AERIAL FIBER COMMUNICATIONS
- EXISTING AERIAL FIBER COMMUNICATIONS
- PROPOSED UNDERGROUND FIBER COMMUNICATIONS
- EXISTING UNDERGROUND FIBER COMMUNICATIONS
- AERIAL SLACK LOOP
- UNDERGROUND SLACK LOOP W/ TP 4 PULL BOX
- AERIAL CLOSURE
- UNDERGROUND CLOSURE W/ TP 5 PULL BOX

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100 0 100 200 300FT.
SCALE: 1" = 100'

	NAME		NAME
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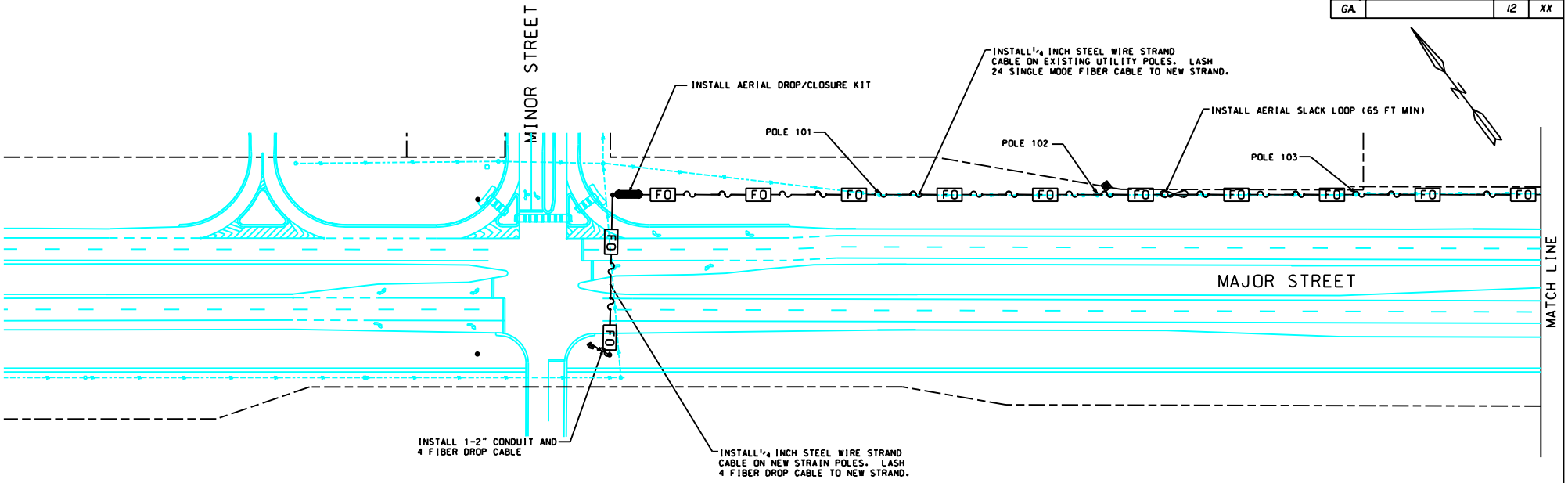
DATE	REVISIONS	DATE	REVISIONS

GEORGIA
DEPARTMENT OF TRANSPORTATION
COMMUNICATION ROUTING PLAN

STATE	PROJECT NUMBER	SHEET NUMBER	TOTAL SHEETS
GA.		12	XX



POLE NUMBER	OWNER	COMMUNICATION CABLE POA (FT.)
101	GA. POWER	19
102	GA. POWER	18.5
103	BELLSOUTH	18.5

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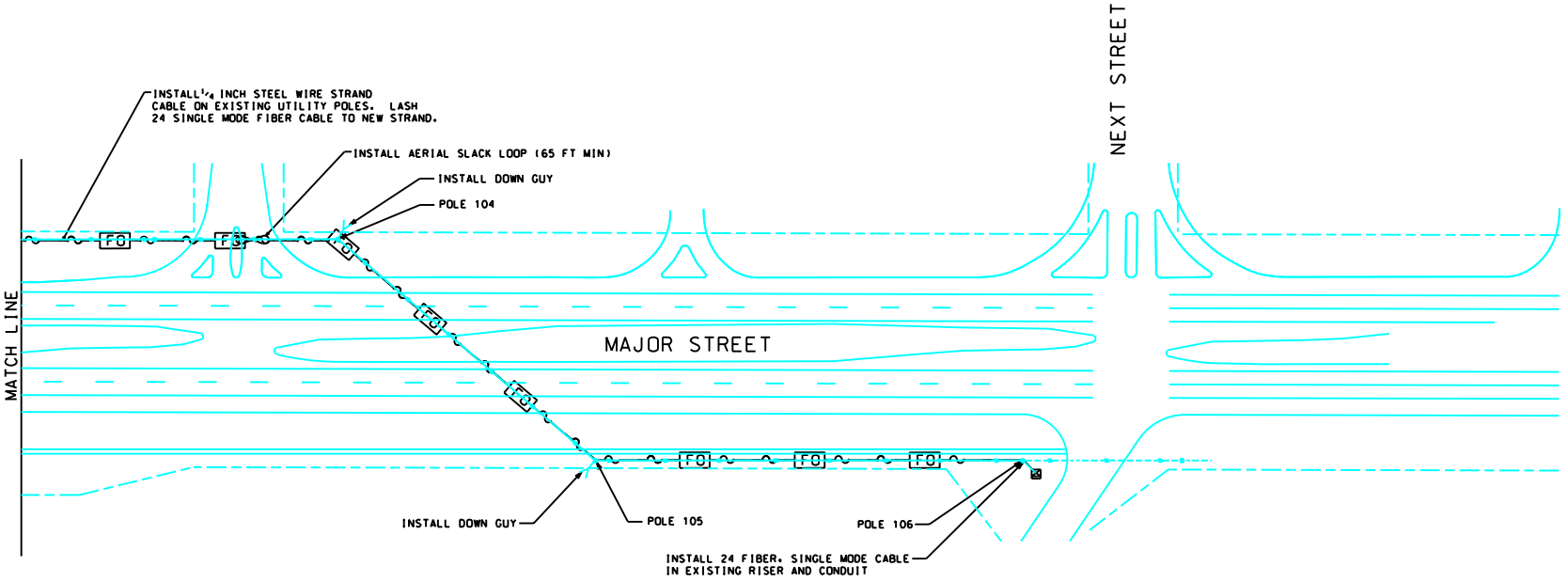
50 0 50 100 150FT.
SCALE: 1" = 50'

	NAME		NAME
DESIGNED BY		DRAWN BY	
CHECKED BY		CHECKED BY	

DATE	REVISIONS	DATE	REVISIONS

GEORGIA
DEPARTMENT OF TRANSPORTATION
COMMUNICATION PLAN
MINOR STREET TO NEXT STREET

STATE	PROJECT NUMBER	SHEET NUMBER	TOTAL SHEETS
GA.		13	XX



POLE NUMBER	OWNER	COMMUNICATION CABLE POA (FT.)
104	GA. POWER	19
105	BELLSOUTH	18
106	BELLSOUTH	18

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50 0 50 100 150FT.
SCALE: 1" = 50'

NAME		NAME
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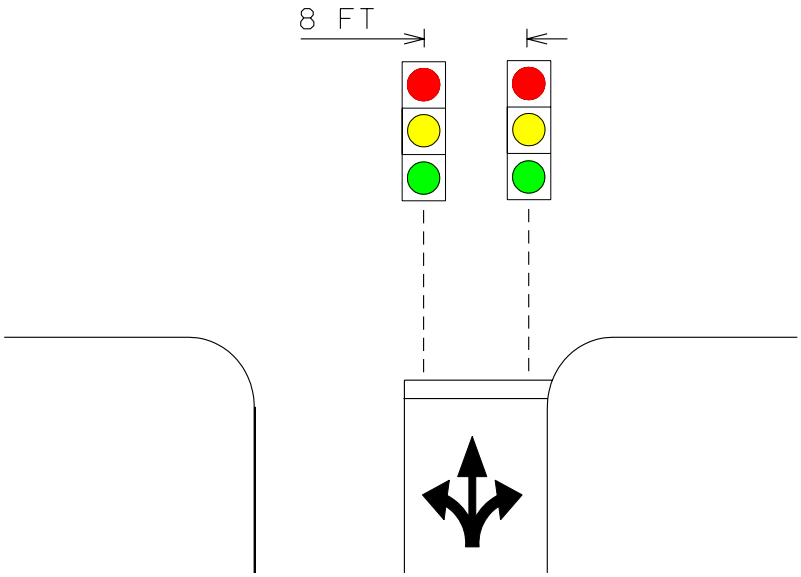
DATE	REVISIONS	DATE	REVISIONS

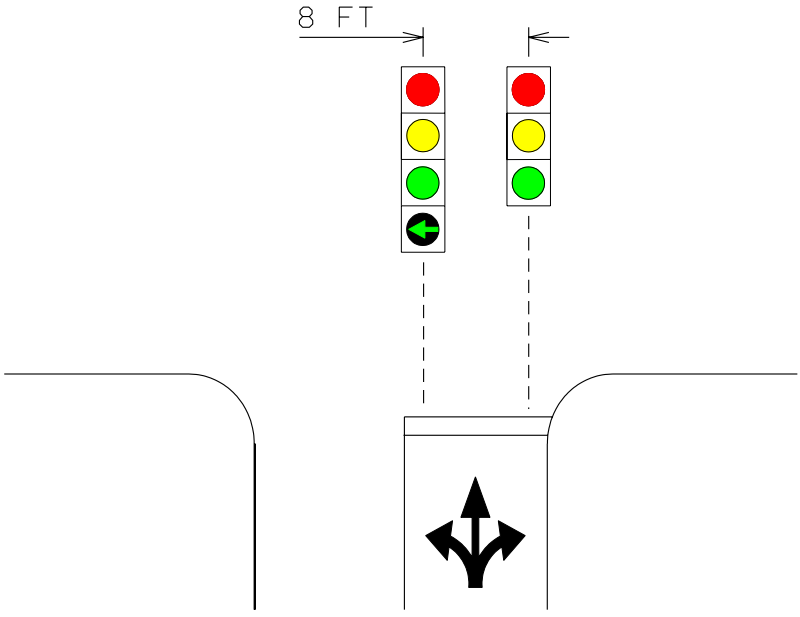
GEORGIA
DEPARTMENT OF TRANSPORTATION
COMMUNICATION PLAN
MINOR STREET TO NEXT STREET

Appendix B

Vehicular Signal Head Placement Examples

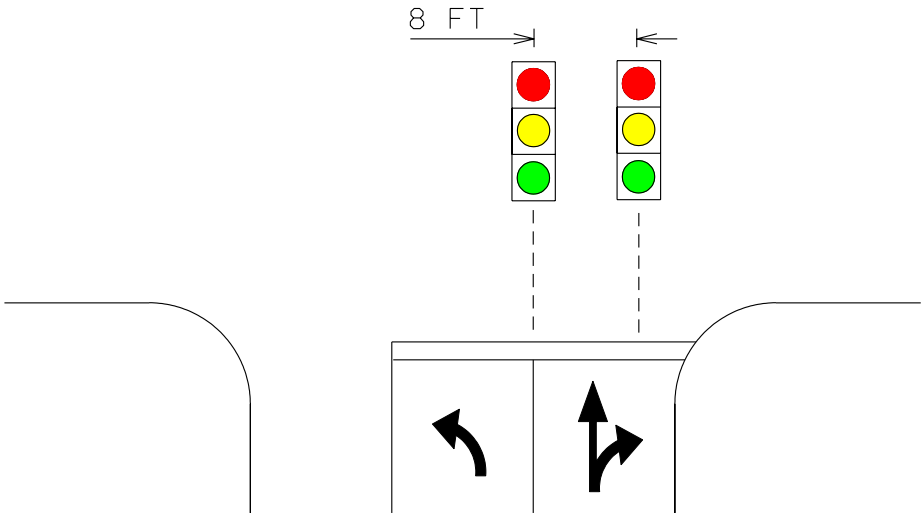


ONE LANE APPROACH - MULTI-PURPOSE LANE
FIGURE I-A

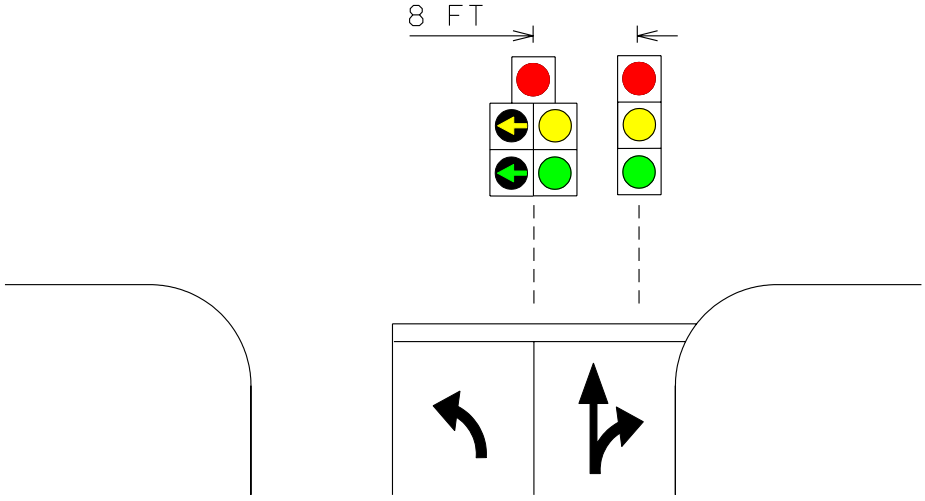


ONE LANE APPROACH - MULTI-PURPOSE LANE
SPLIT-PHASED OPERATION
FIGURE I-B

	TYPICAL TRAFFIC SIGNAL PLACEMENT ONE LANE APPROACH	FIGURE 1

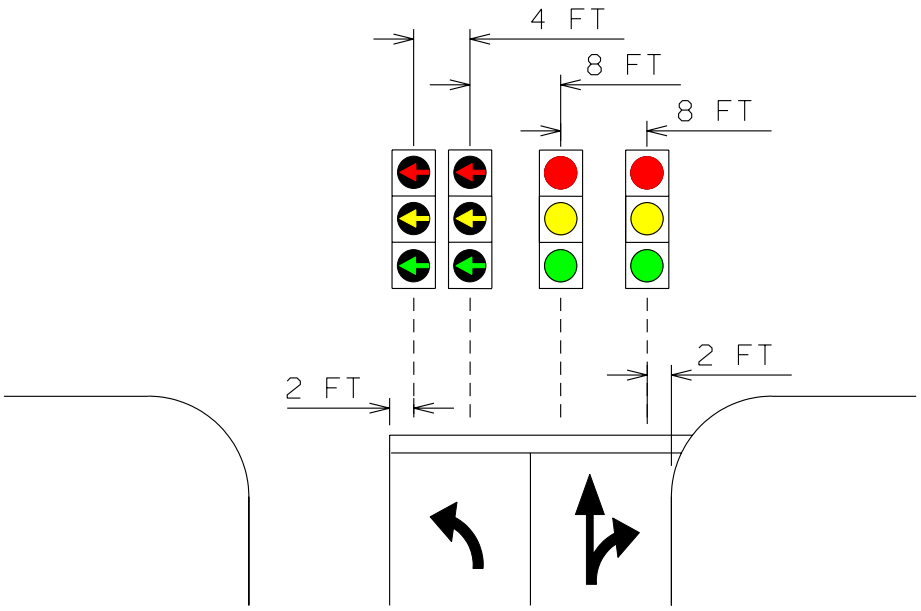


SINGLE LEFT TURN LANE - PERMISSIVE LEFT TURNS
FIGURE 2-A

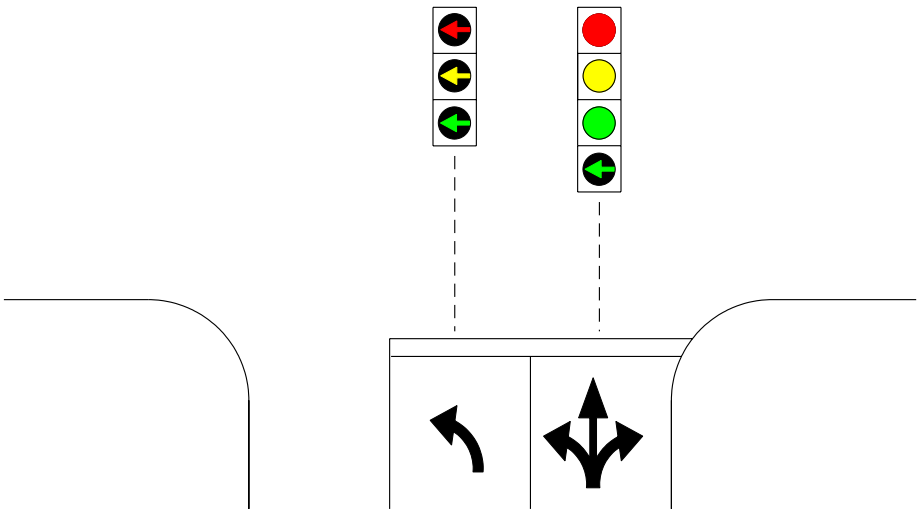


SINGLE LEFT TURN LANE - PROTECTED/PERMISSIVE LEFT TURNS
FIGURE 2-B

	TYPICAL TRAFFIC SIGNAL PLACEMENT TWO LANE APPROACH WITH LEFT TURN LANE	FIGURE 2

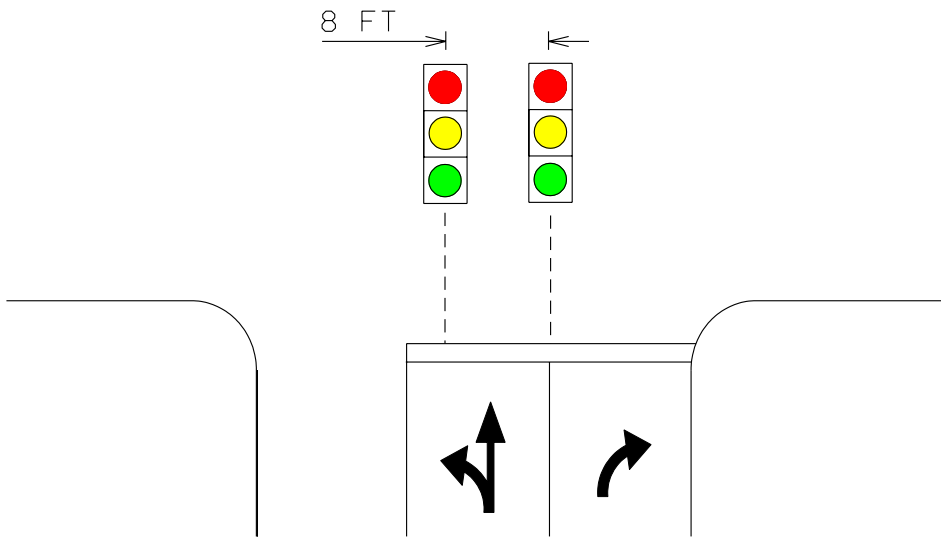


SINGLE LEFT TURN LANE - PROTECTED ONLY LEFT TURNS
FIGURE 3-A

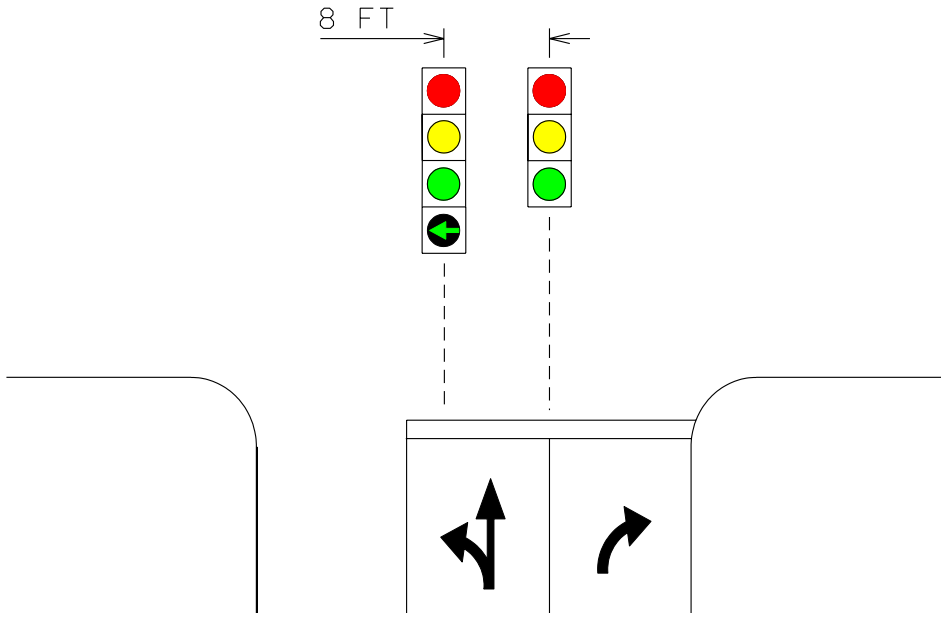


SEPARATE LEFT TURN LANE COMBINATION LEFT TURN/THRU/RIGHT TURN LANE
SPLIT-PHASED OPERATION ONLY
FIGURE 3-B

	TYPICAL TRAFFIC SIGNAL PLACEMENT TWO LANE APPROACH WITH LEFT TURN LANE	FIGURE 3



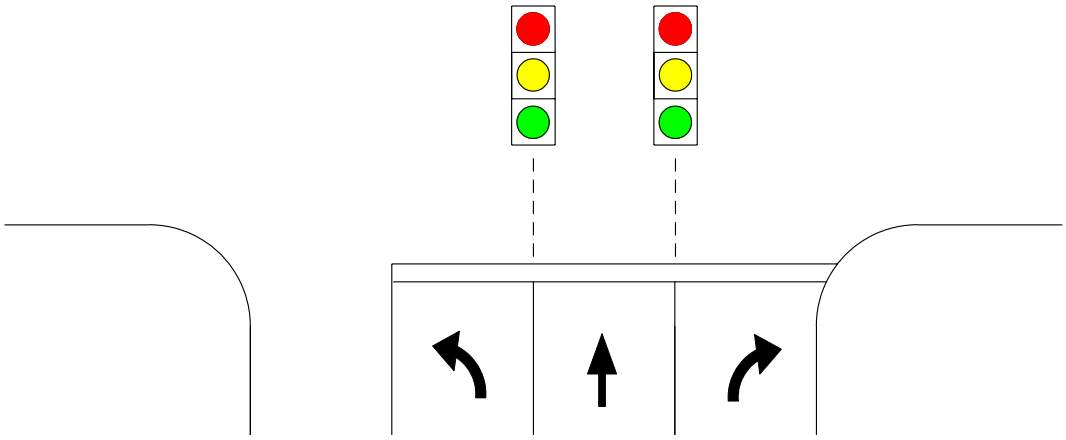
COMBINATION THRU/LEFT TURN LANE - NO PROTECTED MOVEMENTS
FIGURE 4-A



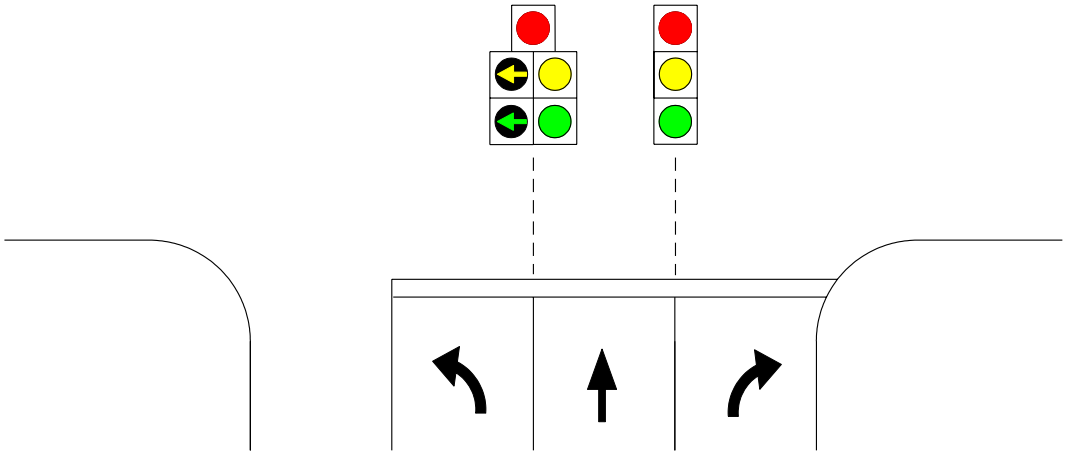
COMBINATION THRU/LEFT TURN LANE
SPLIT-PHASED OR LEAD-LEFT TURN MOVEMENTS ONLY
FIGURE 4-B

TYPICAL TRAFFIC SIGNAL PLACEMENT
TWO LANE APPROACH
WITH RIGHT TURN LANE

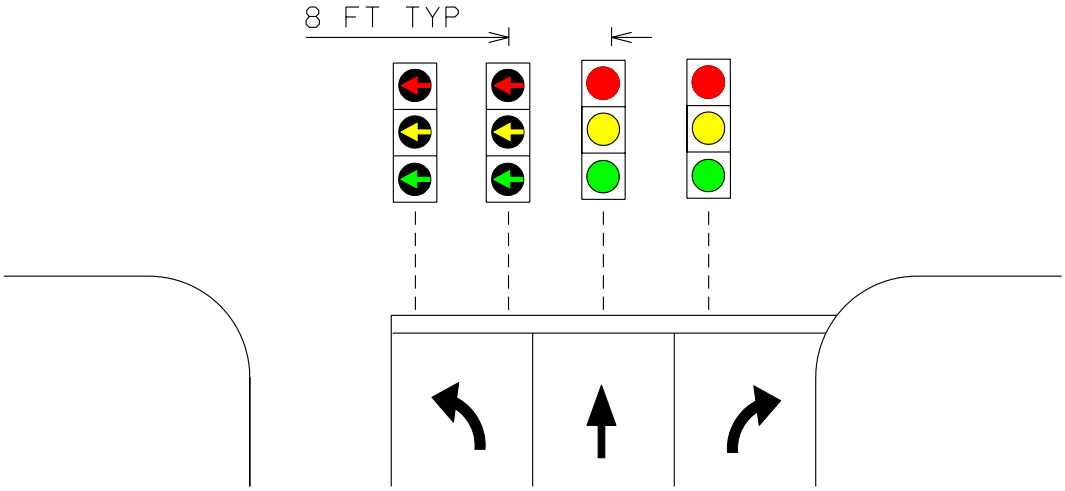
FIGURE 4



SINGLE LEFT TURN LANE W/ SEPARATE THRU AND RIGHT TURN LANES
PERMISSIVE LEFT TURNS
FIGURE 5-A

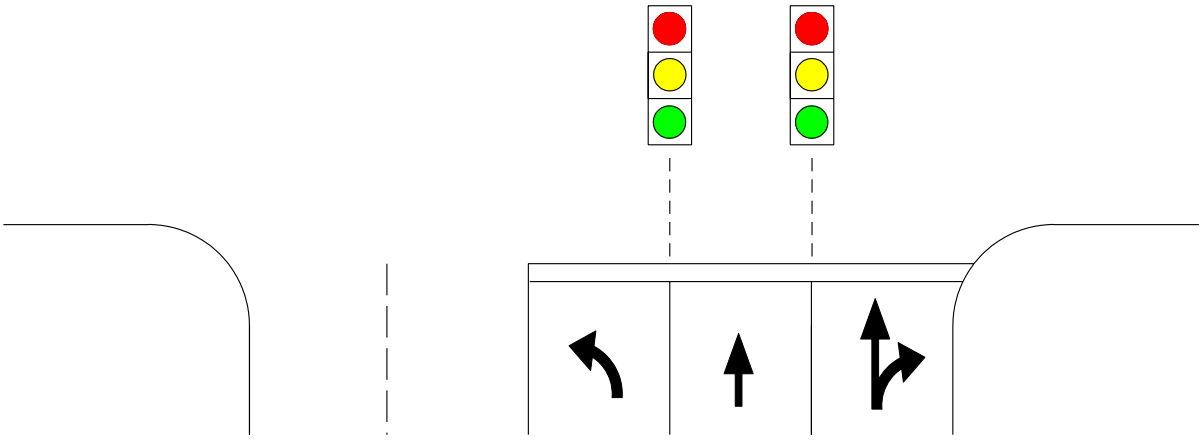


SINGLE LEFT TURN LANE W/ SEPARATE THRU AND RIGHT TURN LANES
PROTECTED/PERMISSIVE LEFT TURNS
FIGURE 5-B

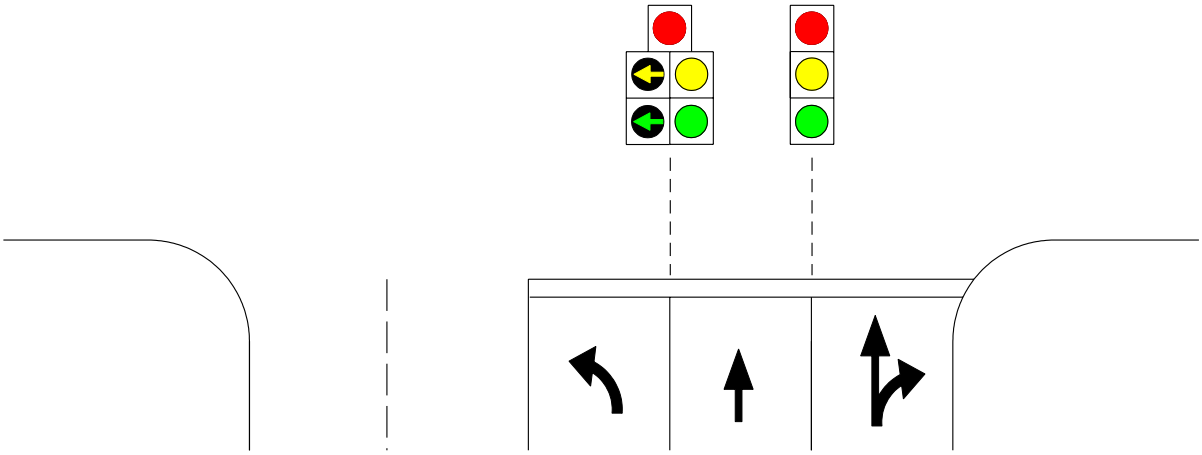


SINGLE LEFT TURN LANE W/ SEPARATE THRU AND RIGHT TURN LANES
PROTECTED ONLY LEFT TURNS
FIGURE 5-C

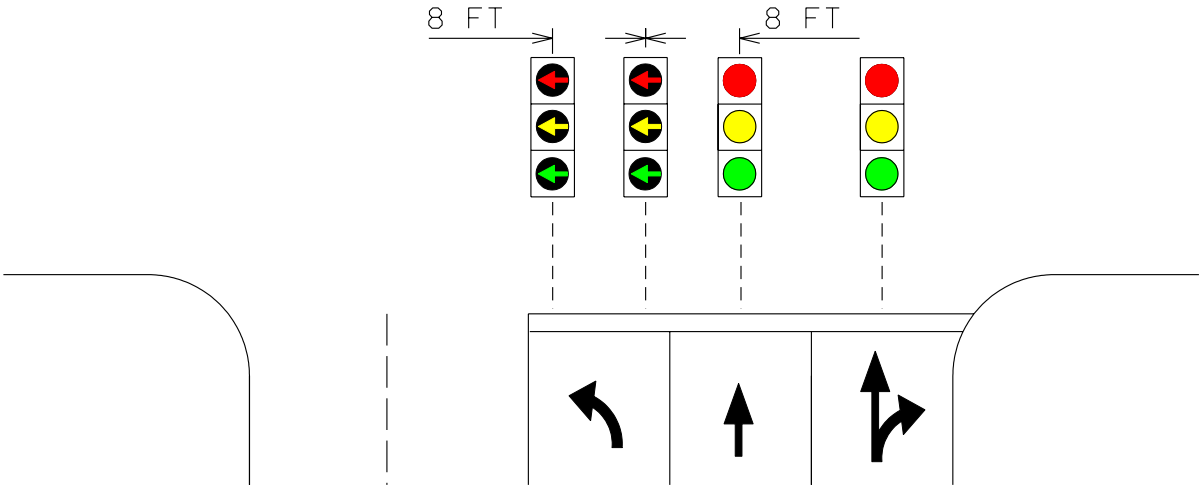
	TYPICAL TRAFFIC SIGNAL PLACEMENT THREE LANE APPROACH WITH SEPARATE TURN LANES	FIGURE 5



SINGLE LEFT TURN LANE W/ SEPARATE THRU LANE AND SHARED THRU/RIGHT TURN LANE - PERMISSIVE LEFT TURNS
FIGURE 6-A

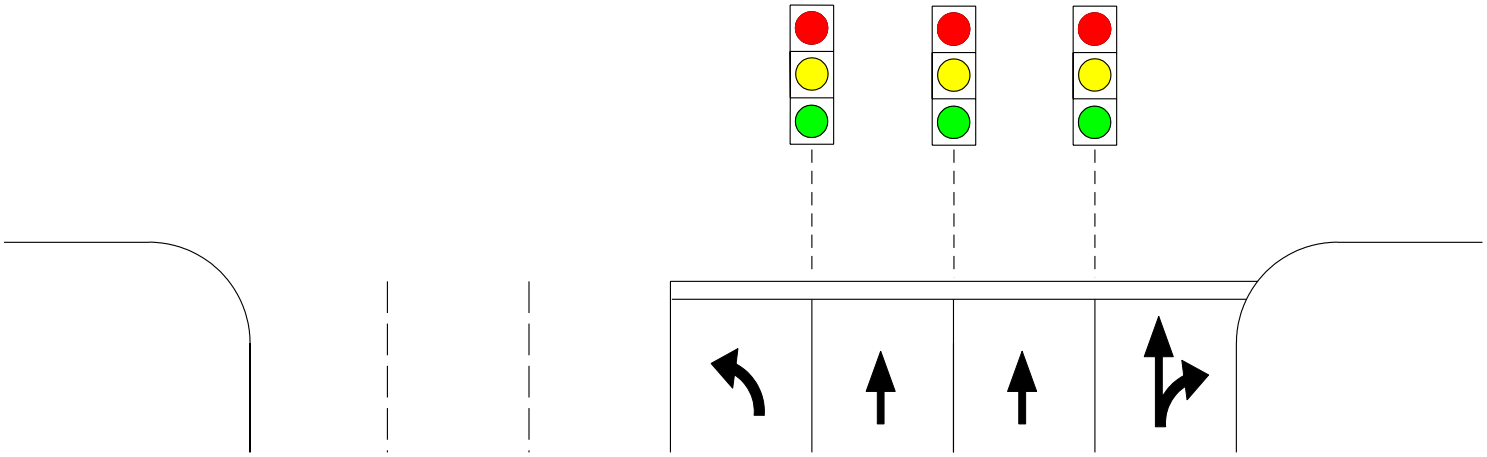


SINGLE LEFT TURN LANE W/ SEPARATE THRU LANE AND SHARED THRU/RIGHT TURN LANE - PROTECTED/PERMISSIVE LEFT TURNS
FIGURE 6-B

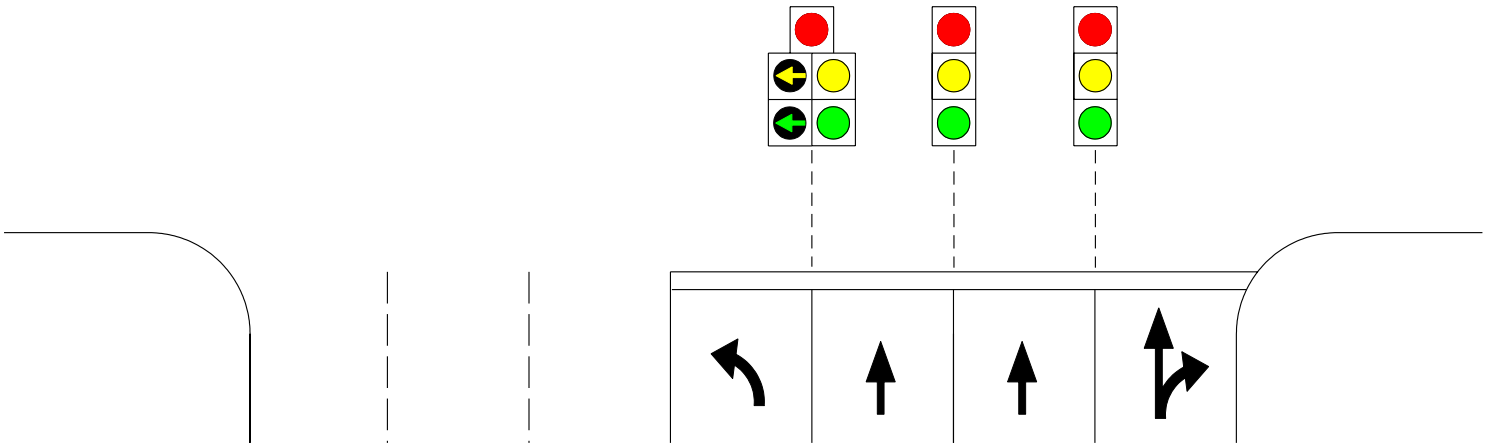


SINGLE LEFT TURN LANE W/ SEPARATE THRU LANE AND SHARED THRU/RIGHT TURN LANE - PROTECTED ONLY LEFT TURNS
FIGURE 6-C

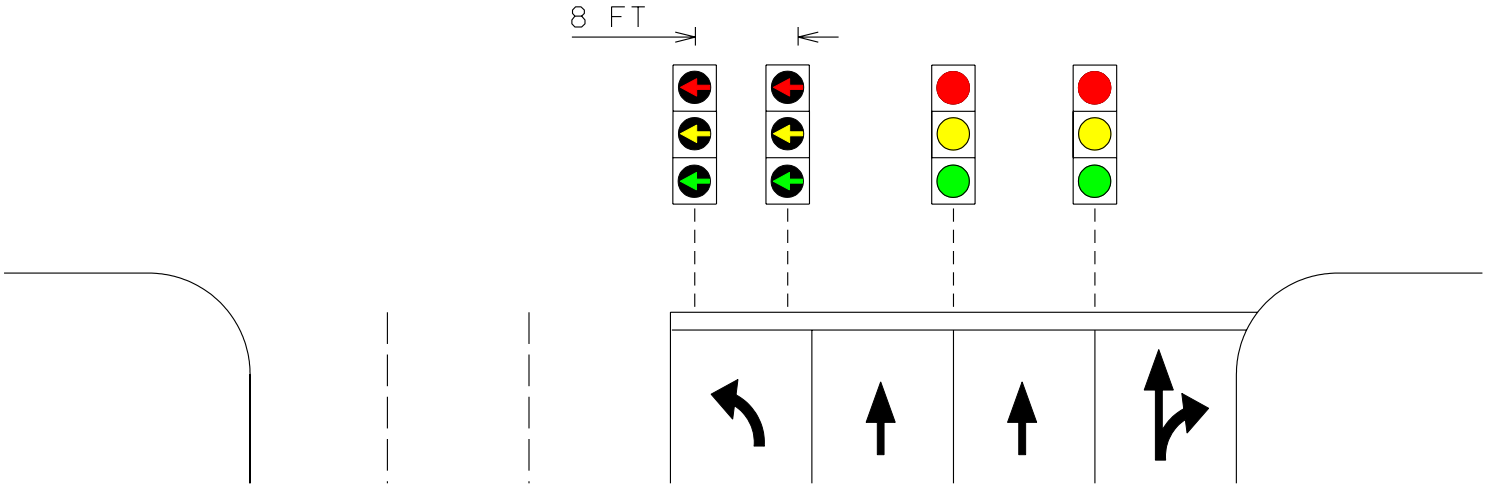
	TYPICAL TRAFFIC SIGNAL PLACEMENT THREE LANE APPROACH WITH TWO THRU LANES	FIGURE 6



SINGLE LEFT TURN LANE W/ TWO SEPARATE THRU LANES AND ONE SHARED THRU/RIGHT TURN LANE - PERMISSIVE LEFT TURNS
FIGURE 7-A

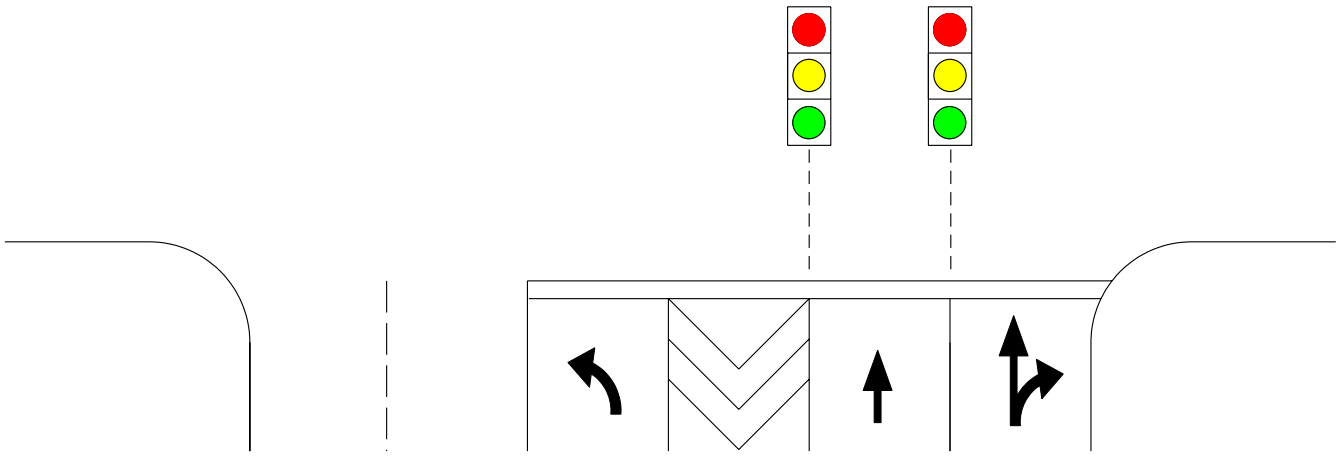


SINGLE LEFT TURN LANE W/ TWO SEPARATE THRU LANES AND ONE SHARED THRU/RIGHT TURN LANE - PROTECTED/PERMISSIVE LEFT TURNS
FIGURE 7-B

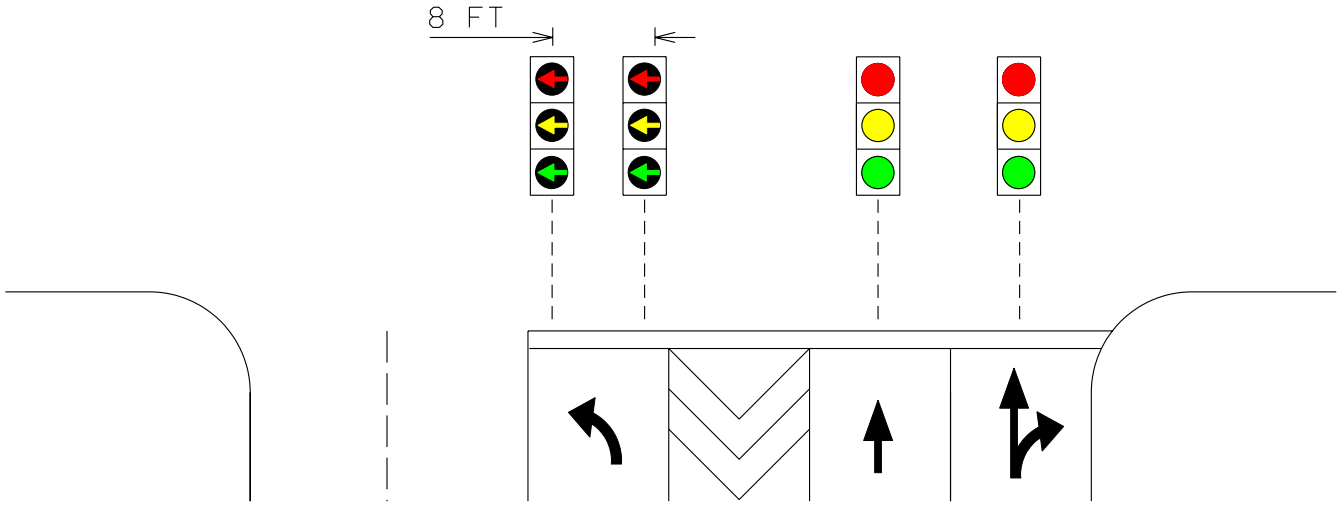


SINGLE LEFT TURN LANE W/ TWO SEPARATE THRU LANES AND ONE SHARED THRU/RIGHT TURN LANE - PROTECTED ONLY LEFT TURNS
FIGURE 7-C

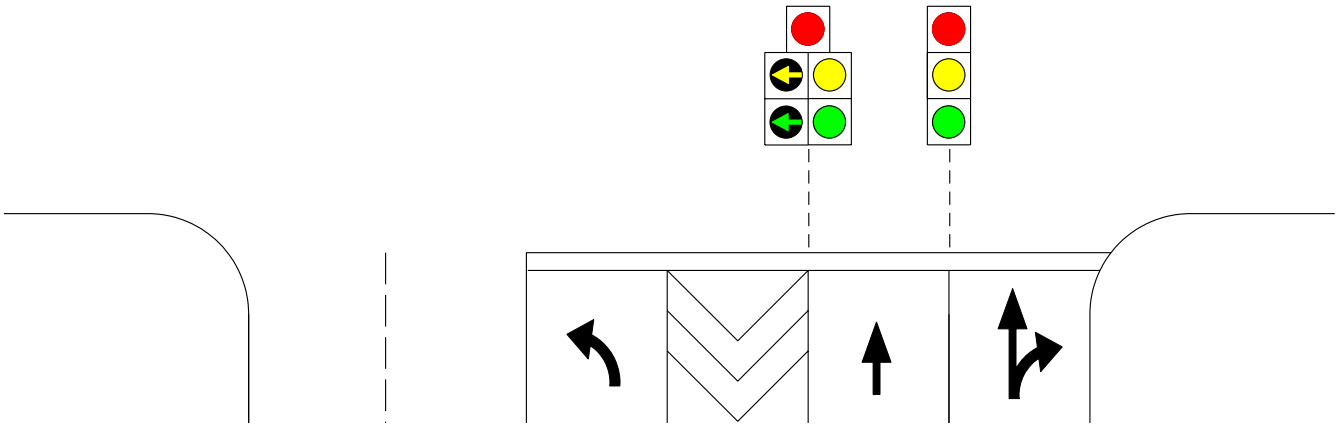
	TYPICAL TRAFFIC SIGNAL PLACEMENT FOUR LANE APPROACH WITH THREE THRU LANES	FIGURE 7



SINGLE LEFT TURN LANE W/ SEPARATE THRU LANE AND
SHARED THRU/RIGHT TURN LANE - PERMISSIVE LEFT TURNS
FIGURE 8-A

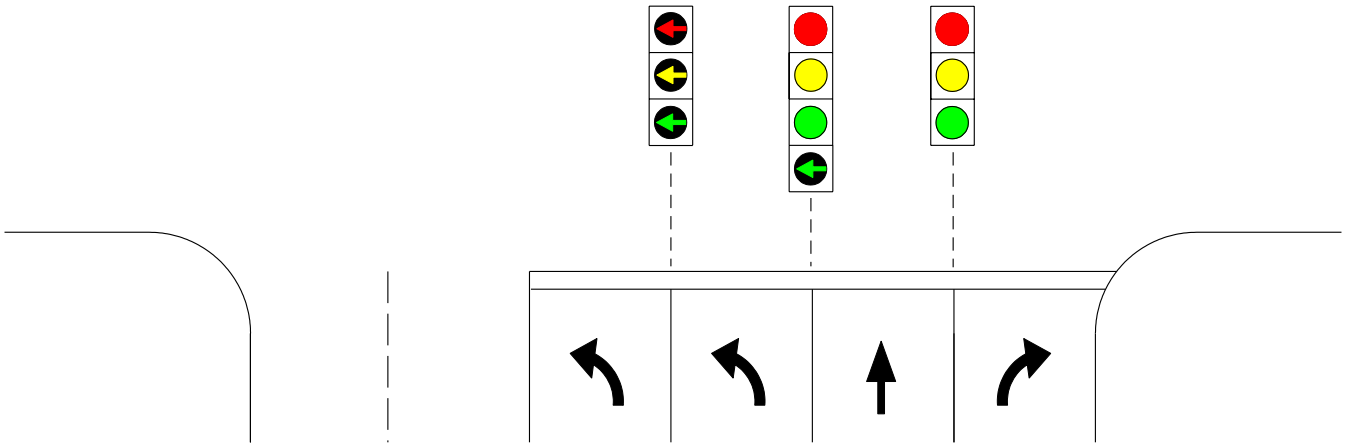


SINGLE LEFT TURN LANE W/ SEPARATE THRU LANE AND
SHARED THRU/RIGHT TURN LANE - PROTECTED ONLY LEFT TURNS
FIGURE 8-B

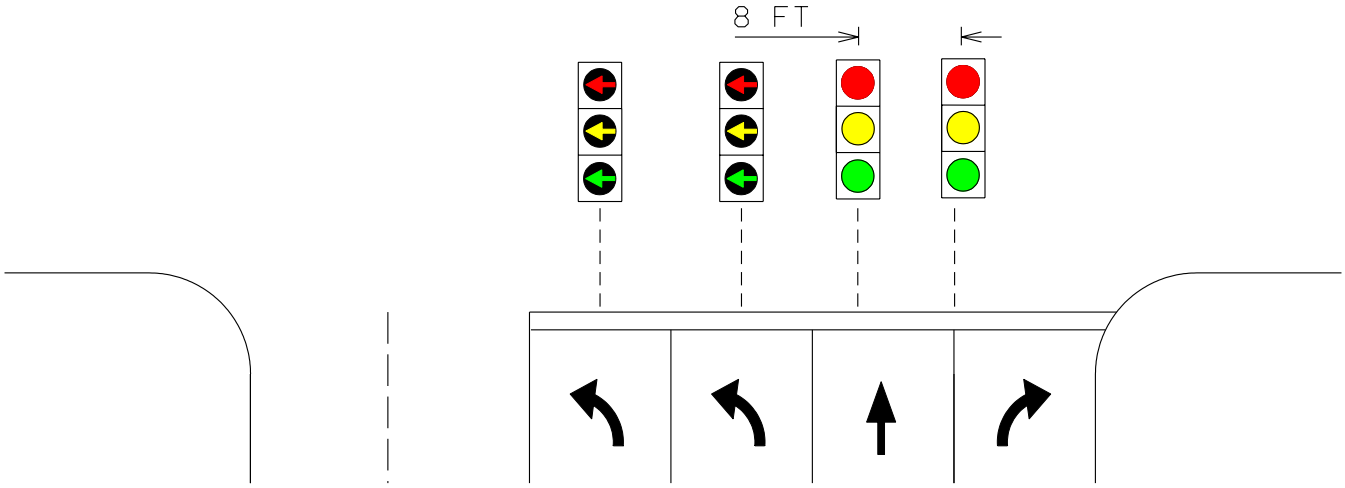


SINGLE LEFT TURN LANE W/ SEPARATE THRU LANE AND
SHARED THRU/RIGHT TURN LANES - PROTECTED/PERMISSIVE LEFT TURNS
FIGURE 8-C

	TYPICAL TRAFFIC SIGNAL PLACEMENT THREE LANE APPROACH WITH CHANNELIZED LEFT TURN	FIGURE 8

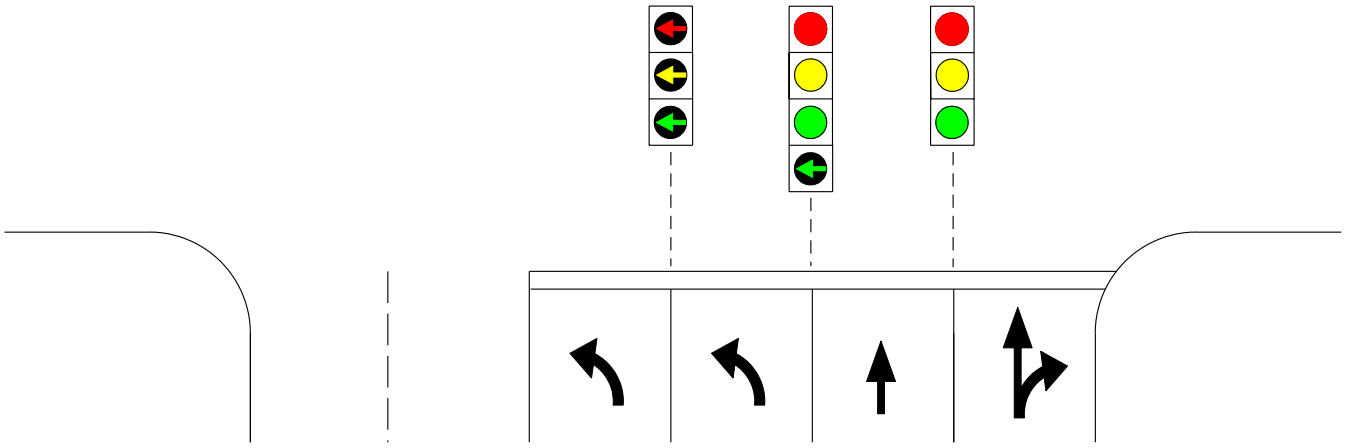


DUAL LEFT TURN LANES WITH SEPARATE THRU AND RIGHT TURN LANES
SPLIT PHASED OPERATION
FIGURE 9-A

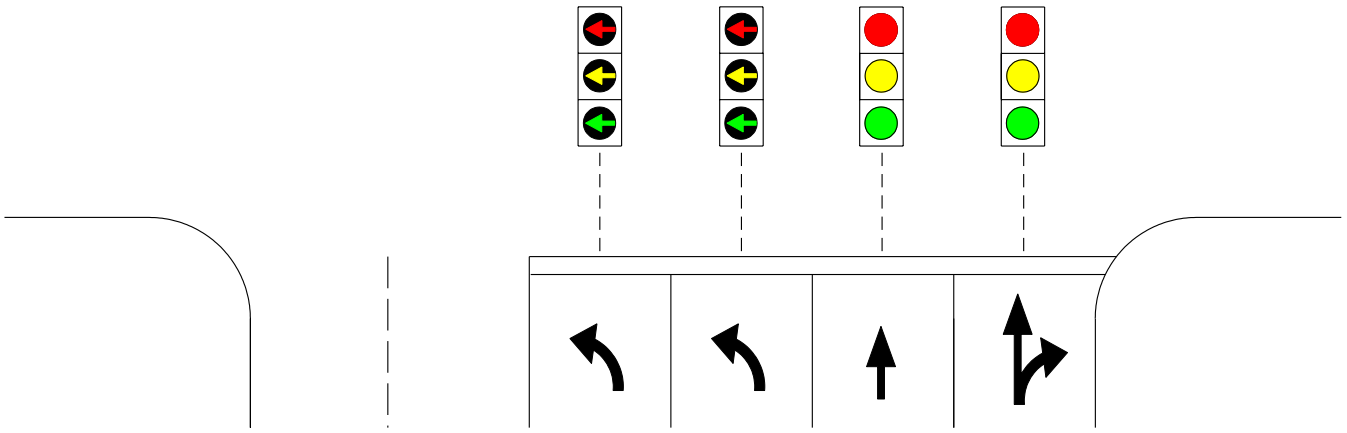


DUAL LEFT TURN LANES WITH SEPARATE THRU AND RIGHT TURN LANES
STANDARD DESIGN
FIGURE 9-B

	TYPICAL TRAFFIC SIGNAL PLACEMENT FOUR LANE APPROACH WITH DUAL LEFT TURN LANES	FIGURE 9

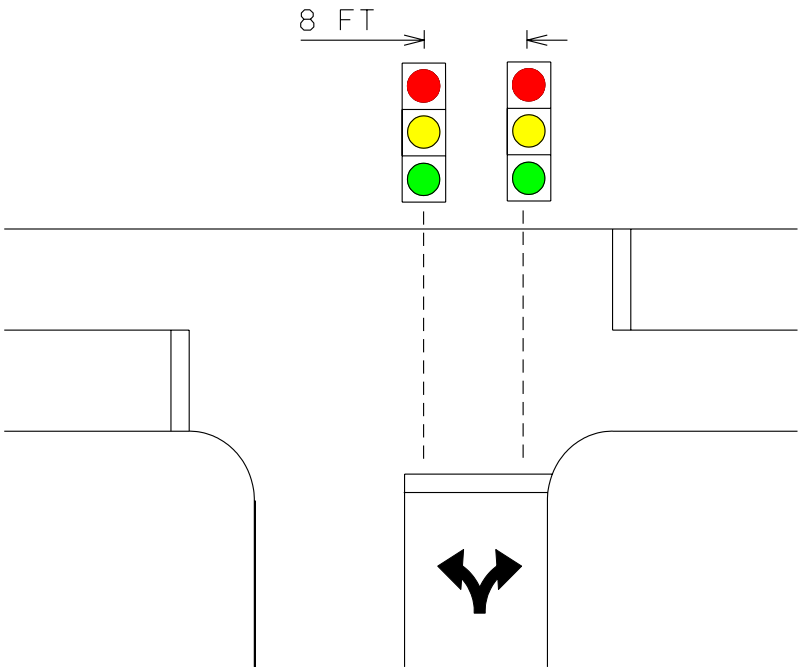


DUAL LEFT TURN LANES WITH THRU LANE AND SHARED THRU/RIGHT TURN LANE
SPLIT PHASED OPERATION
FIGURE 10-A

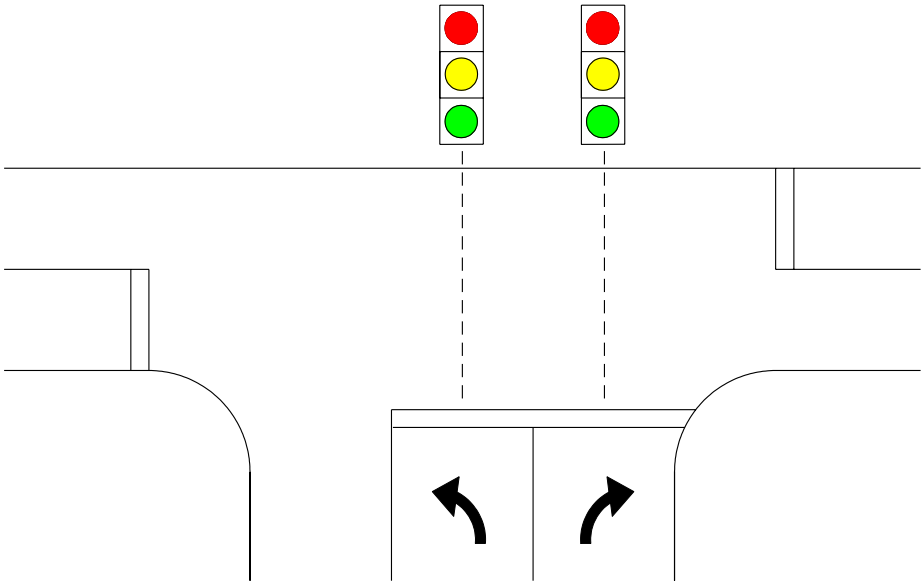


DUAL LEFT TURN LANES WITH THRU LANE AND SHARED THRU/RIGHT TURN LANE
STANDARD DESIGN
FIGURE 10-B

	TYPICAL TRAFFIC SIGNAL PLACEMENT FOUR LANE APPROACH WITH DUAL LEFT TURN LANES	FIGURE 10

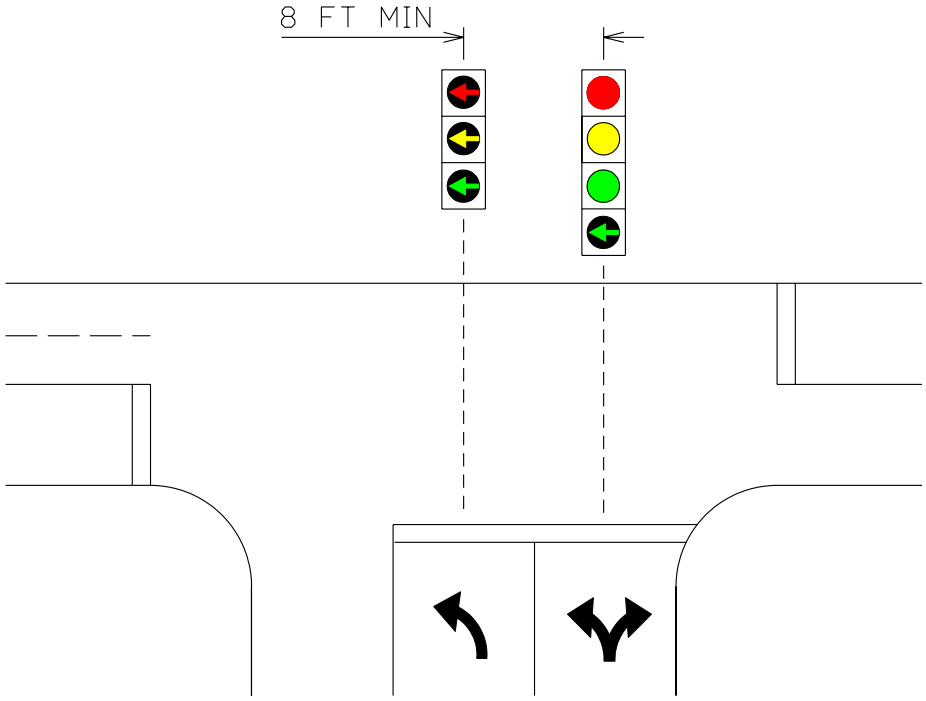


"T" INTERSECTION
ONE LANE APPROACH
FIGURE II-A

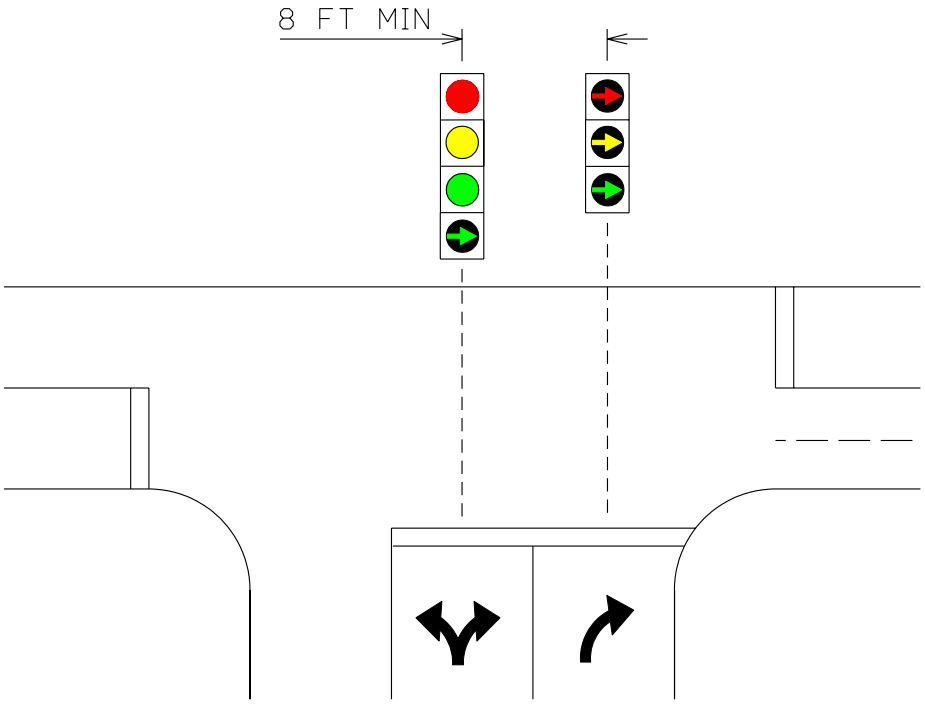


"T" INTERSECTION
TWO LANE APPROACH
SEPARATE LEFT AND RIGHT TURN LANES
FIGURE II-B

	TYPICAL TRAFFIC SIGNAL PLACEMENT ONE & TWO LANE APPROACH TO "T" INTERSECTION	FIGURE 11

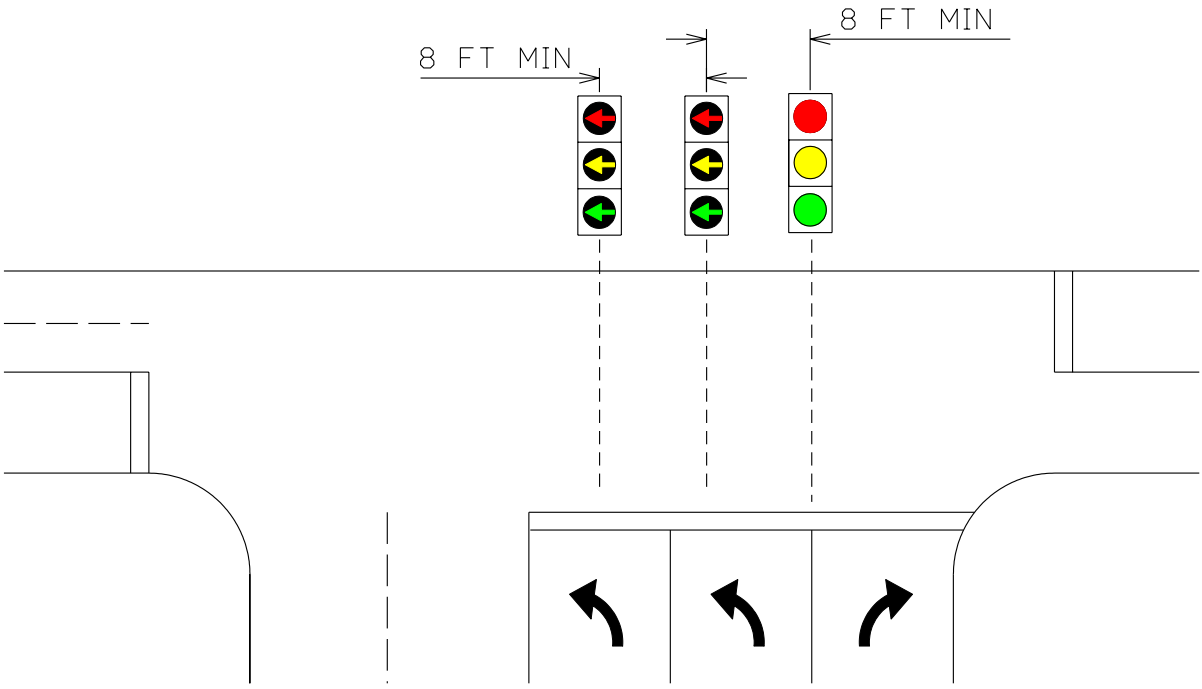


"T" INTERSECTION
SEPARATE LEFT TURN LANE
COMBINATION LEFT TURN/RIGHT TURN LANE
FIGURE 12-A

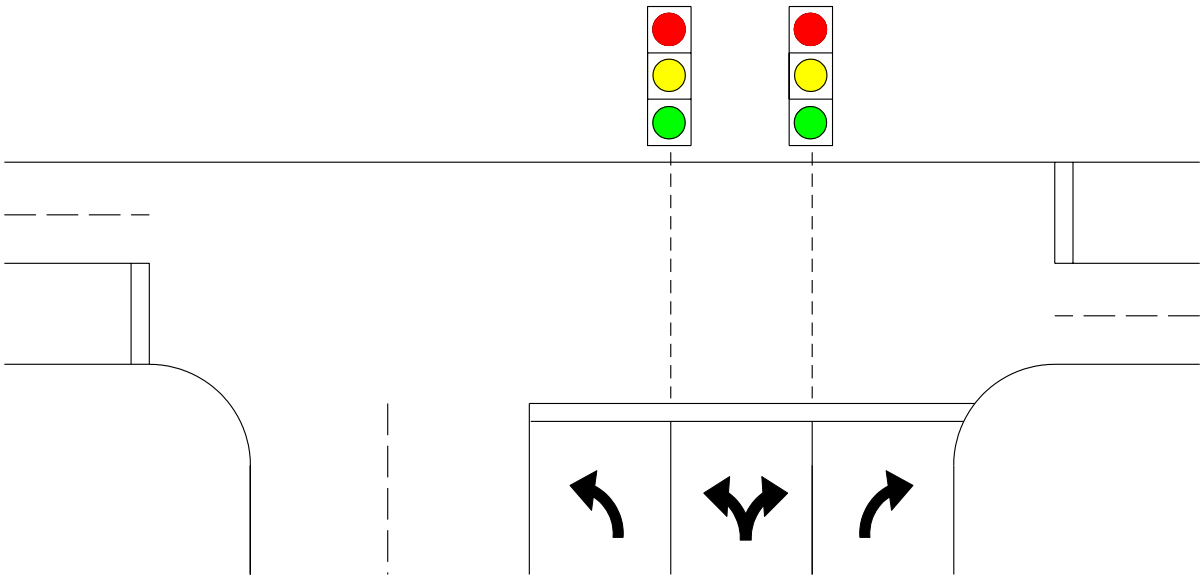


"T" INTERSECTION
SEPARATE RIGHT TURN LANE
COMBINATION LEFT TURN/RIGHT TURN LANE
FIGURE 12-B

	TYPICAL TRAFFIC SIGNAL PLACEMENT TWO LANE APPROACH TO "T" INTERSECTION	FIGURE 12



"T" INTERSECTION
THREE LANE APPROACH
DUAL LEFT TURN LANES W/ SEPARATE RIGHT TURN LANE
FIGURE 13-A



"T" INTERSECTION
THREE LANE APPROACH
SEPARATE LEFT TURN LANE AND RIGHT TURN LANE WITH SHARED CENTER LANE
FIGURE 13-B

	TYPICAL TRAFFIC SIGNAL PLACEMENT THREE LANE APPROACH TO "T" INTERSECTION	FIGURE 13